1st PhD Symposium Gembloux Agro Bio Tech

March 5th 2025 - Espace Senghor
Av. de la Faculté d'Agronomie 11,
5030 Gembloux

@ReDgbxabt
@redgbxabt
redgxabt@uliege.be

LIÈGE université
Gembloux
Agro-Bio Tech

Main Topics :

Talks :

Session 1 :

Session 1 :

Session 2 :

Posters :

Socio-Economics :

Ecosystems :

Soil Health & Carbon Stocks :

Biocontrol :

Molecular & Biochemical Processes :

Biotechnologies :

Food Sciences :

Forest Degradation In Congo Basin: The Need For A Shift Of Focus From Forest Logging To Small-Scale Agriculture

Authors : Timothée Besisa and Jean-François Bastin

Email address : t.besisa@student.uliege.be

Research unit : Biodiversité et Paysage (Biodiversity ecology and Landscape)

Abstract :

The tropical forests of the Congo Basin are under intense anthropogenic pressure, leading to an increase in deforestation of 3.9% and forest degradation of 0.09% over the last 20 years. While the methods for monitoring deforestation are relatively well established, those associated with forest degradation are not universally accepted. This article is based on a literature review based on the hypothesis that the most important types and causes of degradation in the Congo Basin region have not yet been sufficiently studied. Our analysis highlighted 8 categories of forest degradation drivers: selective logging, agriculture, livestock grazing in forests, uncontrolled fires, hunting, harvesting of non-timber forest products, mining, and road infrastructure development. Among these drivers, shifting agriculture is the most frequently cited as the most significant cause of forest degradation in the region. However, our results show that only 22% of the studies reviewed address this category, and over 65% of them focus primarily on the consequences of industrial timber harvesting. However, this latter is recognized as a minor cause of forest degradation, accounting for 1 to 5% of total degradation in the region. Consequently, most of the methods developed to monitor degradation focus on detecting gaps in the canopy, over a short period of time ranging from 0 to 5 years, a process which therefore only partially corresponds to one of the eight categories of causes identified. These results therefore illustrate the urgent need for a shift in focus in scientific research towards the development of innovative methods, which can be developed over time, to measure, quantify and monitor the various impacts of all causes of forest degradation.

Keywords : Forest Degradation, Dense Tropical Rainforest, Small-Scale Agriculture, Forest Logging, Congo Basin

Assessing Farm Schools' Role In Peasant Agroecology Training: Key Insights From The "*Mouvement d'Action Paysanne*" (MAP)

Authors : Mireille De Graeuwe, Yves Brostaux, and Kevin Maréchal

Email address : mdegraeuwe@uliege.be

Research unit : Modélisation et développement (Modeling and development)

Abstract :

Agriculture faces significant challenges that require new approaches to teaching agroecology. In Belgium, the "Independent Peasant School" (EPI), developed by the "Mouvement d'Action Paysanne" (MAP), offers a network of farm schools that blend hands-on practices with theoretical training. This model aims to empower participants with the knowledge and skills necessary for peasant agroecology, fostering local food systems and sustainability.

This study seeks to evaluate the training of MAP's farm school network in enhancing professional skills and empowering learners as changemakers. It focuses on understanding the perceived quality, immersion experience, and post-training outcomes for graduates.

A mixed-methods approach was employed, combining qualitative observations, thematic analysis of survey responses, and quantitative statistical evaluations. Data were collected through an online survey targeting 67 former learners from three active MAP farm schools. The survey assessed satisfaction, immersion (flow), professionalization outcomes, and changemaker capabilities.

The results indicate high levels of satisfaction (mean score: 7.93/10) and immersion during training. Learners valued the diversity and relevance of hands-on activities but highlighted areas for improvement, including clearer pedagogical structures and enhanced theoretical content. Approximately 31% of graduates who enrolled in the training program with the motivation to establish themselves in agriculture successfully did so, while 44% secured employment in related sectors. A significant proportion reported that the training influenced their personal and professional decision-making, with notable impacts on their consumption habits and daily lives. The findings suggest the potential of farm schools to serve as catalysts for agroecological transitions in Europe, contingent on addressing identified pedagogical gaps and offering stronger post-training support systems.

Keywords : Farm Schools, Agroecology, Professionalization, Change-Maker

Towards Sustainable Diets And Farming Systems Through Land Use Optimization

Authors : Tom Desmarez, Jérôme Bindelle, and Benjamin Dumont

Email address : tom.desmarez@uliege.be

Research unit : Ingénierie des productions végétales et valorisation (Plant Sciences)

Abstract :

The prevailing industrialized food system presents significant health and environmental challenges, raising concerns about its sustainability. Addressing these challenges requires the development of locally adapted solutions that consider the unique agronomic and socio-economic conditions of each region.

This study aims to investigate the impact of transforming the food system on regional self-sufficiency and land use by designing an optimization model for crop allocation across various pedoclimatic conditions in Wallonia.

We examined three diets—CURRENT, TYFA, and EAT-Lancet—under both conventional and organic farming practices, incorporating food waste reduction scenarios of 30% and 10%. The model allocated crops based on regional agronomic and socio-economic data to assess the potential for achieving self-sufficiency and optimizing land use.

Our results indicated that the CURRENT diet, regardless of farming practice, did not achieve regional self-sufficiency. However, adopting the TYFA or EAT-Lancet diets allowed self-sufficiency and freed up land for alternative uses under conventional farming. Food waste reduction played a crucial role in enhancing self-sufficiency under organic farming. These findings offer valuable insights for policy-making aimed at improving food security in Wallonia, with potential applications for other regions seeking to improve local food security.

Keywords : Food Autonomy – Organic Farming – Land Use Optimization – Sustainable Diets

Addressing Global Food System Challenges: The Transdisciplinary Agrosystem Platform For Integrated Research Project (TAPIR)

Authors : Roxane Dhommée, Roxane Bruhwyler, Caroline De Clerck, Pierre Delaplace, Benjamin Dumont, Xavier Fettweis, Frédéric Lebeau, Vincent Leemans, Bernard Longdoz, Sébastien Massart, Jennifer Michel, Hervé Vanderschuren, and Jerôme Bindelle

Email address : roxane.dhommee@uliege.be

Research unit : Ingénierie des productions végétales et valorisation (Plant Sciences)

Abstract :

Global food systems face a pressing challenge: ensuring equitable access to food for a growing population (8.2 billion people in 2024) while producing healthier food, adapting to climate change, and reducing environmental impacts. Agricultural reforms are crucial, as agriculture lies at the heart of food production. However, industrialized, specialized farming systems have caused biodiversity loss, environmental degradation, and a decline in the quality of essential natural resources. Climate change further exacerbates food insecurity through rising temperatures, shifting rainfall patterns, and increased pest pressures, threatening crop yields globally.

The Transdisciplinary Agrosystem Platform for Integrated Research (TAPIR) aims to address these challenges through two primary approaches. First, it explores dietary diversification to promote healthier and more sustainable eating habits. For instance, TAPIR investigates the effects of reducing animal product consumption in favor of legumes, aligning with the EAT-Lancet Commission's proposed "ideal" diet, designed to sustainably support 10 billion people. Second, the project incorporates agroecological principles into agricultural practices. These principles aim to enhance ecological functions, improve functional biodiversity, and build resilient food systems under climate change. Key actions include improving nitrogen fixation using legumes, rethinking farm energy use and environmental impact with a focus on greenhouse gas (GHG) emissions, and introducing agrivoltaics—a combination of agriculture and solar energy.

TAPIR relies on two state-of-the-art infrastructures. The first is a 108-hectare experimental farm within *AgricultureIsLife*. This farm hosts several long-term experiments such as EcoFoodSystem where cultural systems optimized according to the EAT-Lancet diet, and managed with agroecological practices are studied. The second is the Ecotron platform within *EnvironmentIsLife*, equipped with eight chambers simulating climate change scenarios. These chambers will allow to evaluate the performances of EcoFoodSystem rotations under projected climatic conditions for the next 40 years, as outlined by the IPCC.

Additionally, TAPIR is advancing soil biological research through the Edaphic Laboratory, a soil lab dedicated to soil biology supported by *AgricultureIsLife* and *EnvironmentIsLife*, that will be complementary with the soil physics and soil chemistry labs. This platform focuses on soil microbiology in agroecological systems, aiming to (1) monitor agricultural soil health/quality bioindicators in long-term experiments and (2) assess these indicators under climate change. Key bioindicators include microbial diversity and biomass, enzymatic activity, and beneficial fungi like arbuscular mycorrhizae.

In conclusion, the TAPIR initiative aims to explore the potential of agroecological practices as a pathway toward more sustainable and resilient food systems. Its findings promise to inform transformative approaches for agriculture in the face of climate change.

Keywords : Climate Change, Agricultural Soil, Bioindicator, Sustainable Agrosystems

Resource Access And Forest Exploitation For Charcoal Production Around The City Of Lubumbashi, Democratic Republic Of The Congo

Authors : Kasanda Mukendi Nathan,Fabio Berti, Ngoie Ndjibu Laurent, Nkulu Mwine Fyama Jules, Useni Sikuzani Yannick, Philippe Lebailly, and Jan Boagert

Email address : N.kasanda@uliege.be

Research unit : Modélisation et développement (Modeling and development)

Abstract :

Charcoal production in rural areas of the Democratic Republic of Congo serves as a source of household income while simultaneously contributing to deforestation and forest degradation. This study aims to analyze the modes of access to forest resources by charcoal producers and their exploitation during charcoal production in the rural area of Lubumbashi. Surveys were conducted among 20 professional charcoal producers, revealing that the majority (55%) acquired land through purchase. On average, each charcoal producer owns 2.4 hectares, of which 0.96 hectares are actively exploited over a period of 1.6 years (19 months). The deforestation rate is estimated at 505.3 m2, or 0.05 ha per month. The most commonly harvested species include Julbernardia paniculata, Pterocarpus angolensis, Brachystegia spiciformis, Brachystegia microphylla, Pterocarpus tinctorius, and Marquesia macroura. At the time of felling, these trees exhibit an average diameter of 41.5 ± 11.3 cm and an average height of 44.4 ± 11.4 cm. A total of 55% of charcoal producers do not apply any selection criteria for tree felling, while 5% consider both tree diameter and height, and 35% rely solely on diameter. Most producers are unfamiliar with carbonization techniques other than the traditional earth kiln method, despite being aware of certain factors affecting yield. In conclusion, this study highlights the significant pressure exerted on miombo woodland resources and underscores the importance of mitigating this pressure through the adoption of improved charcoal production techniques to ensure the sustainability of this activity in the rural area of Lubumbashi.

Keywords : Natural Resources, Land Access, Charcoal, Deforestation, Sustainable Production

Land Cover Dynamics In The Northwestern Virunga Landscape: An Analysis Of The Past Two Decades In A Dynamic Economic And Security Context And Security Context

Authors : Charles Mumbere Musavandalo, Kouagou Raoul Sambieni, Jean Pierre Mate Mweru, Jean-François Bastin, Chantale Shalukoma Ndukura, Timothée Besisa Nguba, Julien Bwazani Balandi, and Jan Bogaert

Email address : Charles.MumbereMusavandalo@student.uliege.be

Research unit : Biodiversité et Paysage (Biodiversity ecology and Landscape)

Abstract :

The Beni region in the eastern Democratic Republic of Congo is grappling with socioeconomic development and security challenges that have affected its natural ecosystems, especially those located in the northern Virunga National Park. This study aims to document the anthropization of the northwestern Virunga landscape from 1995 to 2021 in the context of insecurity. Using a cartographic approach and ecological landscape analysis tools, this study delves into overall landscape changes through a comparative analysis of protected and unprotected areas. These investigations focus on landscape composition, transitions between land cover classes, and the spatial transformation process. The northwestern Virunga landscape is undergoing significant land cover changes due to the influence of insecurity on socioeconomic activities, primarily agriculture. Agricultural land encompasses a larger area than other land cover types. However, its expansion has decelerated since the 2000s. The loss of the forested area is discontinuous. During relatively stable periods (1995–2005), forests exhibited a reduction of up to 2.90% in area, while in the period of return of Iturian refugees to their province, followed by terrorist insecurity in Beni (2005-2021), the forested area increased by 2.07%. Savannah areas, which are mainly located in the graben rift valley and near Butembo, have been more heavily affected by human activity than forests. Ultimately, the apparent stability of the landscape can be attributed to its protected areas, especially Virunga National Park.

Keywords : Forest Loss, Protected Area, North Kivu, Land Cover, Army Faction

Gender And Intersectional Analysis Of Agricultural Value Chains For Youth Engagement In Rwanda

Authors : Eugene Rutabagaya R., Erickson Bisetsa, Innocent Mumararungu, John Rwirahira, Gisaro M. Ya-Bititi, and Philippe Burny.

Email address : eugene.rutabagayar@doct.uliege.be

Research unit : Ingénierie des productions végétales et valorisation (Plant Sciences)

Abstract :

Youth engagement in agriculture is recognized as a quick and effective way to address problems of rural unemployment, poverty and food insecurity. The interest of this paper is on identifying factors that influence youth engagement in value chains. The study was conducted in 9 districts of Rwanda, focusing on five key crops: Maize, Irish potatoes, Beans, Chilies and Avocado. Both quantitative and qualitative methods were used for data collection. Results from the study point to a segmentation of youth engagement in value chains along gender lines. First young men and women displayed differentiated considerations in opting to a specific value chain and across its segments. Second, the study established the existence of differentiated prioritization of needs between young men and women involved in value chains, as well as gender disparities in relation to ownership and control over productive resources and assets. Third, the study noted that young women continue to face particular bottlenecks in securing leadership positions within agricultural organizations, namely cooperatives, entailing the lack of leadership capacity and skills, mobility constraints, limited access to resources and assets, low education levels and domestic work burden. The study suggests deliberate measures to address the needs of young women and men in value chains development, prioritizing financial solutions adapted to the needs of young men and women to boost their access to productive resources, affirmative actions that promote young women's inclusion in lucrative segments of value chains, and awareness interventions to address social norms. Likewise, streamlining existing governance structures of farmer cooperatives will enhance youth engagement and unlock employment opportunities for young women and men in agriculture.

Keywords : Agricultural Value Chains, Gender, Intersectionality, Youth, Rwanda

Challenges And Prospects For Semi-Industrial Production Of *Bili-Bili*, A Local Sorghum-Based Beer In Chad.

Authors : Sig-Ngar Masrabaye

Email address : masarabaye.sig-ngar@doct.uliege.be

Research unit : Modélisation et développement (Modeling and development)

Abstract :

Bili -bili, a local beer made from sorghum, is one of the most popular and oldest in Chad. It is part of the daily life of the populations of the Logone and Chari basins, in the south of Chad, where it is produced and widely consumed. Its industrialization, the social and environmental issues, the economic and strategic perspectives that characterize it are at the heart of our research project.

The aim is to contribute to the thinking on the possibilities of semi-industrial scale production of quality sorghum-based beer in Chad.

To address the subject, we will adopt the action research approach, based on field work, by adopting qualitative analysis tools (observations, interviews, discussions, statements, case studies, etc.) and quantitative analysis tools (surveys, polls, etc.). The objective is to stay in the field as long as possible in order to better understand the context, specify the objectives, establish an action plan, and propose practical solutions to resolve the specific problem posed. It is also a question of finding the relevant technical arguments and methodological tools that can be used to locally produce *bili -bili* based on good commercial quality sorghum, capable of generating significant added value.

Keywords : Sigma

Pattern Of Tropical Moist Forest Dynamics In The Kahuzi-Biega National Park Landscape, Eastern DRC

Authors : Nadège Cirezi Cizungu, Jean François Bastin, Yannick Useni, Raymond Lumbuenamo Raymond, and Jan Bogaert

Email address : n.cirezi@doct.uliege.be

Research unit : Biodiversité et Paysage (Biodiversity ecology and Landscape)

Abstract :

The Kahuzi-Biega National Park (KBNP), the most important protected area in the Albertine Rift and a Key Biodiversity Area (KBA) located in eastern Democratic Republic of Congo, has lost ~10% of its undisturbed Tropical Moist Forest (TMF) between 1990 and 2023 due to anthropogenic pressures, leading to its degradation and deforestation.

This study analyzes the spatial pattern of TMF dynamics in KBNP landscape by assessing landscape composition around major transition classes and characterizing their immediate environment.

From the Landsat images classified by Van Cutsem et al (2021), a transition matrix was created for the period 1990-2023. For the main transition classes, a pixel- based sampling was conducted and around each pixel multi-scale windows (3×3, 9×9, and 27×27 pixels) has been created. For each window, landscape composition was assessed through frequency analysis and mean comparisons between classes. The immediate environment of sampled classes, including elevation and proximity to major disturbances (roads, mining, fires), was also characterized using a random forest classification model with 500 decision trees.

The most significant transitions involve the degradation (10.17%) and deforestation (5.76%) of undisturbed TMF. Class diversity around focal pixels vary across scales and transition classes (p-value < 2.2e-16), while maintaining consistent trends. The Undisturbed TMF class is s distinguished by its composition characterized by low pixel diversity, dominance of over 70% by pixels of the same class, and greater distance from major disturbances. It dominates low-altitude areas. Despite retaining significant ecological integrity, PNKB requires enhanced efforts to curb human encroachment in intact zones.

Keywords : Tropical Moist Forest, Deforestation, Degradation, Random Forest, Kahuzi-Biega National Park

Structural Attributes Of Forest Stability At The Stand Level.

Authors : Hugo de Lame, Jean-François Bastin, and Christian Messier

Email address : hugo.delame@uliege.be

Research unit : Biodiversité et Paysage (Biodiversity ecology and Landscape)

Abstract :

Temperate forests in Wallonia are increasingly vulnerable to climate change, a sensitivity exacerbated by the consequences of centuries of silvicultural practices focused on production. They face rising disturbance frequencies such as drought intensification and outbreaks of pathogens and bark beetles, making resilience-building essential to their future stability. However, quantifying and estimating resilience remains challenging due to heavy management which could mask potential tendencies and the lack of a cohesive approach that integrates stand- and landscape-level dynamics.

This research aims to identify the key attributes of resilience in temperate forests, emphasizing structural complexity and its influence on ecosystem stability indicators. By bridging local-scale field inventories based on fixed trait values and large-scale analyses using satellite-derived indices, the study addresses gaps in understanding multi-scale resilience. Specifically, it investigates how structural attributes at both stand and landscape levels contribute to resilience, offering insights into which traits should be prioritized to help temperate forests adapt to ongoing and future environmental changes.

Keywords : Forest, Structure, Remote Sensing, Landscape Ecology, Resilience

Continental Compensations In Forest Attributes Overshadow The Influence Of Climate On Tropical Forests' Carbon Stock.

Authors : Pauline Depoortere, David Bauman, Adeline Fayolle, and Jean-François Bastin

Email address : pauline.depoortere@uliege.be

Research unit : Biodiversité et Paysage (Biodiversity ecology and Landscape)

Abstract :

Tropical forests are one of the largest carbon pools on the planet and one of the largest remaining uncertainties in the global carbon budget, challenging the development of accurate climate projections and adapted conservation actions. Although climate, topography, and soil are recognized as key drivers of diversity and dynamics of tropical forests, their direct impact on biomass and carbon stocks remains unclear. The crux lies in shifting away from the idea that forest biomass is a singular entity to considering it as an aggregated property shaped by multiple attributes of the forest stand, such as basal area, canopy height, quadratic mean diameter, stem density, and average wood density, each responding independently to environmental factors. Gathering tropical forest inventory data from over 2,000 plots across the tropics, we demonstrate that there is no straightforward relationship between climate (mean annual temperature, total annual precipitation, and precipitation seasonality) and aboveground biomass, whether at the pantropical or continental scale. Our results indicate that this link is indirect, mediated through compensatory effects among structural attributes along climatic gradients. These compensations vary significantly between continents, offering new perspectives to understand the contrast in forest structural attributes across the tropics. Furthermore, by considering multiple climate datasets, we provide a robust assessment that highlights the importance of accounting for variability in climate data sources when evaluating forest dynamics in tropical regions. These results provide a new understanding of the spatial distribution of forest biomass in the tropics and open promising avenues for reducing uncertainties in the global carbon budget and modelling forest response to global change.

Keywords : Tropical Forests, Aboveground Carbon Stocks, Forest Structural Attributes, Environmental Drivers

Advancing The Modelling Of Runoff Flooding In Ungauged Catchments

Authors : Matthieu Herpoel and Aurore Degré

Email address : matthieu.herpoel@uliege.be

Research unit : Échanges Eau–Sol–Plantes (Water–Soil–Plant Exchanges)

Abstract :

The catastrophic floods of July 2021 in Wallonia underscored the critical need for enhanced runoff and flood hazard predictions, especially in ungauged catchments. These predictions remain challenging, prompting the development of distributed hydrological models such as Hidropixel (Costa et al., 2019; Veeck et al., 2020; Lima et al., 2024), which leverage high-resolution data for improved accuracy.

This study aims to refine the spatialization of runoff volumes and travel times to improve peak discharge estimation. It focuses on identifying optimal hydrological modelling approaches for regional applications, advancing runoff routing methods, and integrating flow obstacles into distributed simulations of runoff and peak discharges.

A literature review of rainfall-runoff models suited for ungauged conditions was conducted, alongside a comparative analysis in three experimental catchments in Wallonia (Bormenville, Mettet, and Chastre). Two approaches were evaluated for flow path assessment: the Hidropixel model and the standard triangular hydrograph method (NRCS-TUH) used in the SCS-CN model. Nash-Sutcliffe Efficiency (NSE) coefficients were calculated to compare observed and simulated hydrographs for 48 rainfall events.

The SCS-CN method provides reliable runoff volume estimates, demonstrating its potential under ungauged conditions and outperforming the calibrated WaterSed model in Chastre and Bormenville. Distributed GIS-based implementations enhance its ability to account for the spatial variability of hydrological parameters. For runoff routing, Hidropixel demonstrates greater NSE values compared to NRCS-TUH, highlighting its superior performance and robustness in detailed spatial runoff modelling, especially at finer spatial resolutions. Despite challenges in data validation, Hidropixel exhibits strong potential for distributed hydrological applications. Future work will focus on incorporating flow obstacles to refine the simulation of spatial runoff dynamics.

Keywords : Rainfall-Runoff Models, Distributed Hydrologic Modelling, Unit Hydrograph, Surface Runoff

Protected Area Creation And Its Limited Effect On Deforestation: Insights From The Kiziba-Baluba Hunting Domain (DR Congo)

Authors : Héritier Khoji, Yannick Useni Sikuzani, and Jan Boagert

Email address : hkhoji@doct.uliege.be

Research unit : Biodiversité et Paysage (Biodiversity ecology and Landscape)

Abstract :

The study examines the spatiotemporal dynamics of landscape anthropization in the Kiziba-Baluba Hunting Domain (KBHD), near Lubumbashi in southeastern Democratic Republic of Congo, facing increasing human threats.

To quantifier the spatiotemporal dynamics of landscape from 1989 to 2023 using remote sensing, Geographic Information Systems (GIS), and landscape ecology principles.

The results reveal a significant decrease in forest cover, declining from 70.33% in 1989 to 26.22% in 2023, with an annual deforestation rate of -1.84%. This deforestation has led to the expansion of savannas (63.93%), agriculture (5.76%), and built-up and bare soil (0.93%) through patch creation and aggregation. The level of landscape disturbance has increased sixfold over 34 years, from 0.42 in 1989 to 2.81 in 2023. The reduction in the size of the largest forest patch and increased spatial isolation show rising fragmentation and dissection, often followed by the attrition of residual patches. These findings highlight the inefficiency of current conservation measures in KBHD, indicating a need for restructuring management, redefining protected area boundaries, developing a suitable management plan, implementing reforestation programs, strengthening enforcement of environmental laws, and actively involving local communities.

Keywords : Anthropogenic Pressure, Miombo Woodland, Protected Areas, Environmental Legislation, Resource Conservation, Ecosystem Services

Anthropogenic Effects On Amphibian Diversity And Habitat Similarity In The Yoko Forest Reserve (YFRE), Democratic Republic Of The Congo

Authors : Loving Musubaho, Léon Iyongo, Jean-Claude Mukinzi, Alain Mukiranya, Jasmin Mutahinga, Marc Dufrêne, and Jan Bogaert

Email address : lov.musubaho@student.uliege.be

Research unit : Biodiversité et Paysage (Biodiversity ecology and Landscape)

Abstract :

Fragmented landscapes have an impact on amphibians, affecting species numbers, distribution and connectivity between populations. This is linked to the specie's ecology, which thus makes them vulnerable to natural habitat disturbance. To understand species-landscape relationships, this study was carried out on amphibians in the YFRE. Objectives : (i) understand the influence of habitat conditions on the distribution of amphibian abundance and species richness; (ii) compare habitats from their amphibian faunas; (iii) determine the similarity rate between the habitats and (iv) determine the indicators species of levels of disturbance in forest habitats.

The analyses showed that Amnirana albolabris, Phrynobatrachus auritus, P. perpalmatus, Leptopelis notatus, L. millsoni, L. christyi, L. ocellatus, Xenopus pygmaeus, Hyperolius platyceps, L. calcaratus, Arthroleptis tuberosus, Ptychadena perreti, Amietia nutti, Arthroleptis variabilis, Cardioglossa leucomystax, and Chiromantis rufescens are indicative of Pf. No species is indicative of Fl & Fd. Species in these two habitats are forest species that adapt to their disturbance conditions.

Anthropogenic disturbance of natural environments negatively affects amphibians. Their interactions with native vegetation call for the definition of management plans to identify appropriate conservation strategies. Additional analyses are required to compare data of different zones. These analyses must be associated with the local characteristics of the study areas. The analysis of changes in amphibian diversity, after deforestation, requires repeating the study as it becomes overgrown.

Keywords : Amphibians, Yoko Forest Reserve, Anthropogenic Effects

Towards Automated Monitoring Of Tropical Forest Ecosystems Through The Largest Trees.

Authors : Antoine Plumacker, Bhély Angoboy Ilondea, Hugo de Lame, Pauline Depoortere, Adeline Fayolle, Marjane Kaddouri, Pierre Ploton, Zoé Rousseau, Arthur VanderLinden, and Jean-François Bastin.

Email address : antoine.plumacker@uliege.be

Research unit : Biodiversité et Paysage (Biodiversity ecology and Landscape)

Abstract :

Monitoring forest structural attributes helps assess ecosystem roles in response to global changes. In Central Africa, field inventories are costly and limited, requiring alternative approaches. In this context, monitoring large canopy trees using a combination of remote sensing and artificial intelligence, through the development of Individual Tree Crown (ITC) detection algorithms, offers significant opportunities. This study aims to test and compare ITC approaches—Detectree2, Segment Anything (SAM)—and optimize them through a hybrid approach, Detectree2SAM, for the automated characterization of structural attributes (crown area and shape) of canopy trees in the Luki Biosphere Reserve, DRC. ITC algorithms differ in tree number estimation and forest cover assessment: SAM detects fewer trees, Detectree2 provides intermediate values, and Detectree2SAM estimates higher densities (Kruskal-Wallis and Dunn tests, $p < 2.2e-16$). Validation using pixel-wise and IoU-based methods shows that Detectree2SAM achieves the highest F1 score in pixel-wise validation (0.853), while Detectree2 obtains the highest IoU F1 score (0.697). Detectree2 and Detectree2SAM exhibit better recall, capturing more tree crowns, whereas SAM has higher precision, reducing false positives. Structural attributes are captured differently across ITC methods: Detectree2SAM favors smaller crowns, Detectree2 detects intermediate-sized crowns, and SAM identifies a broader range. Shape indices reveal higher complexity captured by Detectree2SAM and SAM ($p < 2.2e-16$). Detectree2SAM achieves the lowest error (RMSD = 52.3 m2) in crown area segmentation. For the 20 largest crowns, it shows the best agreement with field data (RMSD area = 41.24 m2, shape index = 0.09), while Detectree2 tends to overestimate. Although improvable, the different ITC models open promising perspectives in forest management, allometry, and phenological monitoring. The integration of time-series data and very high-resolution aerial images could enhance forest characterization, while emphasizing the complementarity with field inventories.

Keywords : Remote Sensing, Individual Tree Crown Detection, Forest Structure, Canopy Monitoring, UAV Inventories

Potential Of Photointerpretation For Vegetation Mapping In Xerophytic Ecosystems Of Southwest Madagascar

Authors : Felana Ramalason, Olivia Rakotondrasoa, Arthur Vander Linden, Guillaume Renard, and Jean-François Bastin

Email address : fn.ramalason@uliege.be

Research unit : Biodiversité et Paysage (Biodiversity ecology and Landscape)

Abstract :

Arid ecosystems, particularly in the southwest of Madagascar, present significant challenges for vegetation mapping due to their structural and physiological complexity. These ecosystems, which are highly impacted by deforestation, require accurate and timely monitoring to support effective conservation and management efforts. This study aims to develop a robust methodology for generating maps of wood cover (WC), height of vegetation (H95), tree cover (TC), and shrub cover (SC) for 2022 in the arid ecosystems of southwest Madagascar. We combine remote sensing data, field inventories, and photointerpretation to improve the precision of vegetation cover estimates in these complex environments. To generate the H95 map, field measurements of vegetation height were combined with satellite-derived variables. A Random Forest model was applied to establish relationships between explanatory variables and field data, allowing for the prediction of H95 across the study area. The WC map was generated using forest inventory data and photointerpretation, while the TC and SC maps were derived from the H95 and WC maps, respectively. Data from optical and radar satellites were integrated, and field inventories from 2023 were used for model validation. The results demonstrate that the integration of radar and optical data, validated with 2023 field inventories, provides accurate vegetation cover estimates. While slight underestimation of shrub cover was observed due to temporal differences between predicted and ground-truth data, the maps produced outperform global reference datasets such as GFCC, GFW, and CGLS-LC100. High-resolution drone data is expected to further improve map accuracy in future studies.

Keywords : Tree Cover, Wood Cover, Shrub Cover, Remote Sensing, Arid Vegetation

Density And Spatial Distribution Of The Main Anthropogenic Disturbances In The Classified Forest Of The Ouémé Supérieur In North Benin.

Authors : Carlo Sodalo, Kouagou Raoul Sambieni, Yves Justin Arcadius Akossou, and Jan Bogaert

Email address : c.sodalo@uliege.be

Research unit : Biodiversité et Paysage (Biodiversity ecology and Landscape)

Abstract :

The dependence of local communities on forest resources generates the disturbance and degradation of these ecosystems. This leads to an increased exploitation of plant resources to offset the increase in food, energy, etc. The classified forest of Ouémé Supérieur in northern Benin; one of the largest reserves in the country, is not immune from the many anthropogenic pressures mentioned above. This study allows us to better understand the importance of these degradation drivers on the forest in order to prioritize interventions for its restoration. A typology of forest disturbance indicators was built based on literature and formal interviews with local authorities and forestry administration officers. Carbonization, wildfires, logging, agriculture and grazing are the main disturbances. The inventory of these different types of disturbance of the classified forest was carried out in 300 plots of 500 m2 each. The analyses were mainly based on presence/absence indices to identify disturbances presenting an alarming risk. A completed PCA indicates that logging was most prevalent in the plots, followed by agriculture and grazing. The forest disturbance gradient based on penetration distance shows that there is a negative and significant relationship between logging and forest penetration distance ($r = -0.56$; $p < 0.05$). This shows that the cuts become rarer when moving towards the interior of the forest. The relationship is however positive and very significant with agriculture ($r=0.81$; $p<0.0001$). Grazing, fires and carbonization are not influenced by distance of penetration. A Chi-square test of independence between the different types of disturbance shows that logging is significantly related to other types of disturbance (agriculture, carbonization, fires, grazing). A significant relationship exists between agriculture and fires, between carbonization and fires. In addition to logging, the type of disturbance "grazing" is not related to other types of disturbance.

Keywords : Anthropogenic drivers, Ouémé Supérieur classified forest, Local communities, Deforestation and degradation

Decline Of European Beech: Impact Of The Local Environment And Climate Change On Beech Forests In Southern Belgium

Authors : Marie-Pierre Tasseroul, Philippe Lejeune, Hugues Claessens, Hugues Titeux, and Yves Brostaux

Email address : mptasseroul@uliege.be

Research unit : Gestion des Ressources forestières (Forest Resources Management)

Abstract :

Fagus sylvatica L. is one of the most widespread tree species in temperate forests of Western Europe which plays an important role in both ecological and economic terms. European beech stands were especially adapted to the past climate but have suffered a decline in last recent years. Climate change and the increased frequency of extreme events seem to be impacting their vitality even if the exact description of this phenomenon is still unclear.

We have monitored 97 plots in southern Belgium in which we have evaluated the state of health of ten to fifteen dominant or co-dominant beech trees during the growing season (2022). To describe the state of health, we used the French method DEPERIS and a simplified version of the European ICP-Forests protocol. The aim of this study is to understand the decline phenomenon in its globality and how local and regional factors can influence it. For each plot, topographic, pedological, past and present climate, local tree environment and sylvicultural data were collected and considered explanatory variables for beech decline. Stand decline, described as the mean defoliation of trees on the plot, and individual tree defoliation are both considered in the analyses. A Random Forest model combined to an analysis of Shapley values explain more than 40% of the variability in beech decline. The results show that (i) climatic factors, as the rise of mean temperatures compared with the long-term climate of the past and the change in rainfall distribution, and (ii) abiotic factors, as available water capacity and the trees' direct local environment, are the most relevant explanatory factors. This research confirms the complexity and interactions between climate change and abiotic conditions in the decline of European beech.

Keywords : Fagus Sylvatica, Forest Vulnerability, Decline

Integration Of Solar-Powered Atmospheric Water Harvesting And Drip Irrigation Water Saving Technologies

Authors : Menglu Wang, Enke Liu, Saud-uz Zafar, Marie-Laure Fauconnier, Xurong Mei, and Caroline De Clerck

Email address : menglu.wang@student.uliege.be

Research unit : Échanges Eau–Sol–Plantes (Water–Soil–Plant Exchanges)

Abstract :

The integration of solar-powered atmospheric water harvesting and drip irrigation water saving technologies offers a promising solution for water and food supply in dry farming areas. However, the degradation of adsorption material kinetics after scaling up, coupled with fluctuations in solar energy, often results in reduced and unstable water production. Herein, a natural peat moss-based photothermal composite water harvesting sponge (SMLC) with a physical and chemical multi-interconnected mesh structure has been developed, using natural water-absorbing plants as a water-absorbing and water-storing matrix, grafted with amphiphilic hydrogel polymers, and embedded with hygroscopic salts and carbon black to enhance its water-absorbing and photothermal conversion properties. This structure significantly reduces vapor diffusion resistance - a crucial factor impeding rapid scale-up kinetics, respectively enabling water uptake of 1.40, 2.43, and 6.42 g/g at 30%, 60%, and 90% relative humidity, with 62% of water released within 30 min, facilitating daily multiple capture-release cycles. Incorporating a hybrid desorption mode that combines photovoltaic electrical and solar heating further achieves stable and high-yield water production. Finally, through simulation and feasibility validation, the agricultural atmospheric water saving irrigation equipment was found to be able to achieve a water yield of 352.4 g m−2 day −1 in 7 days with no human intervention and no external water input, allowing barley and wheat growth of respectively 19 and 25 cm during this technology implementation period. These findings highlight the potential of combining AWH technology with drip irrigation water-saving techniques in dry agriculture as a way to achieve sustainable urban development through the co-production of evapotranspiration water and food.

Keywords : Atmospheric Water Harvesting

Comparison Of Point Counts And Line Transects Survey Methods For Monitoring Breeding Birds In Chinese Farmland

Authors : Hongyan Zheng, Noëlle Klein, Lili Wang, Sonja Kay, Felix Herzog, Rongguang Shi, Rongle Liu, and Jan Bogaert

Email address : HZheng@student.uliege.be

Research unit : Biodiversité et Paysage (Biodiversity ecology and Landscape)

Abstract :

Birds are important biodiversity indicators, making bird monitoring an essential component of biodiversity conservation. We compared point count and line transect survey methods in agricultural landscapes in China to evaluate their comparability in terms of species richness, abundance, Shannon-Wiener index, Simpson's index, Pielou's index, species association, site similarity, and the relationship between landscape heterogeneity and bird diversity. Paired tests (t-test for normally distributed data and Wilcoxon test for non-normally distributed data) were used to compare species richness, abundance, diversity, species association, and site similarity across 16 transects between point counts and line transects. The correlations between landscape variables and bird diversity across the two survey methods were compared using Pearson correlation for normally distributed data and Spearman correlation for non-normally distributed data. Point counts yielded higher species richness, Shannon-Wiener index and Simpson's index per site than line transects. However, there were no significant differences in bird abundance, Pielou's index, species association or site similarity between the two survey methods. Edge density showed a positive correlation with species richness and Shannon-Wiener index across both survey methods. This study highlights the importance of survey method selection in agricultural landscapes. While line transects offer greater time efficiency, point counts capture more species and individuals per unit effort. Edge density was identified as a consistent indicator of bird diversity, emphasizing its role in biodiversity assessments. Multiple visits across seasons and careful consideration of site selection, survey layout, and landscape heterogeneity are recommended to optimize monitoring strategies and data quality.

Keywords : Biodiversity Monitoring, Agricultural Landscapes, Landscape Heterogeneity, Habitat, Bird Survey

High-C/N Straw Inputs Lead To Higher MAOM Than Low-C/N Straws

Authors : Xiaofang Ji and Gilles Colinet

Email address : xiaofang.ji@student.uliege.be

Research unit : Échanges Eau–Sol–Plantes (Water–Soil–Plant Exchanges)

Abstract :

The formation of mineral-associated organic matter (MAOM) from plant litter decomposition is pivotal for climate change mitigation. However, the way in which plant litter of varying qualities influences MAOM formation and decomposition, particularly regarding the quantity of litter inputs, remains largely unclear. This study aimed to determine how the quality of straw (high-C/N (low-quality) wheat (Triticum aestivum L.) versus low-C/N (high-quality) milk vetch (Astragalus sinicus L.)) and its quantity (input level) affect MAOM formation and decomposition. We conducted a 420-day laboratory incubation experiment using low-quality wheat versus low-C/N milk vetch straws added to artificial soil (pure quartz vs. soil with reactive minerals (sandy soil: 5% clay, 10% silt, and 85%)) at input levels of 0, 3, 6, 18, 26, 31, and 35 g C kg-1 soil. Contrary to the Microbial Efficiency-Matrix Stabilization theory, our research indicates that adding high-C/N wheat straw addition led to a significantly greater MAOM content than milk vetch. Notably, the MAOM stabilization efficiency declined at high input levels (26, 31, and 35 g C kg-1 soil) for wheat than for milk vetch. This is further supported by the evidence that reactive minerals slowed the decomposition rate of high-C/N wheat straw more effectively than that of low-C/N milk vetch. Moreover, the lower C:N ratio of the MAOM fraction, the reduced C:N ratio of dissolved organic matter (DOM), and a higher fluorescence index of DOM after adding wheat straw than adding milk vetch straw suggest the significant role of plant-derived organic matter in MAOM formation. Our findings disclose that reactive minerals preferentially protect high-C/N litter over low-C/N litter through direct interaction with plant-derived organic matter, providing a critical pathway for MAOM formation distinct from microbial assimilation. This study highlights the key role of high-C/N straw in the efficient and long-term stabilization of soil C within agricultural practices.

Keywords : Carbon Input Level, Decomposition Rate, Litter Quality, MAOM Formation, Mineral Protection

Impact Of Integrated Crop-Livestock Systems (ICLS) On Soil Microbial Communities And Fertility In Temperate Climates

Authors : S. J. Kambiré, A. Bughin, G. Dossogne, A. Desjardins, J. F. Noël, S. Mabille, F. Debande, J. Philippart, J. F. Bastin, C. De Clerck, and J. Bindelle

Email address : samijoseph.kambire@doct.uliege.be

Research unit : Ingénierie des productions animales et nutrition (Animal Sciences)

Abstract :

Integrated crop-livestock systems (ICLS) combine livestock grazing on temporary grassland sand/or cover crops, promoting efficient nutrient cycling. Although these systems improve soil quality through manure deposition, their impact on soil microbial communities in temperate climates is not well understood.

This study, conducted as part of the EcoFoodSystem trial at Gembloux Agro-Bio Tech in 2024, explores how herbivore behavior and manure deposition during grazing affect soil microbial activity, properties, and subsequent crop fertility. The study focuses on the effects of sheep grazing on four multi-species temporary grasslands (grasses-legumes) and its impact on subsequent maize crops.

Exclusion cages, with or without manure, were used to measure the impact on microbial activity and soil properties over time (0, 3, 6, 13, 32, and 65 days after deposition). Metagenomic analyses and DNA sequencing will identify microbial diversity, including nitrifying bacteria and enzymatic activity such as β-glucosidase. Aerial images captured with drones were used to assess grazing-induced spatial heterogeneity through NDVI calculation.

Preliminary results indicate changes in microbial activity linked to manure deposits. Aerial images showed a reduction in NDVI, from 0.42–0.90 before grazing to 0.42–0.45 after. This decrease, associated with increased spatial heterogeneity (NDVI SD: 0.02–0.12 to 0.15–0.22), correlates positively ($r = 0.697$, $p < 0.01$) with manure density and vegetation regrowth.

In 2025, the study will focus on the persistence of spatial heterogeneity and its impact on nutrient distribution and maize performance. This research enhances the understanding of ICLS in temperate climates and their role in sustainable agriculture.

Keywords : ICLS, Microbial Communities, Soil Fertility, Grazing Heterogeneity, Sustainable Agriculture

Assessing Soil Organic Carbon (SOC) Stability In Belgian Floodplains

Authors : Kovacs, N., Colinet G., Longdoz B., De Clerck C., Vancampenhout K., Verstraeten G., and Meersmans J.

Email address : nicolas.kovacs@uliege.be

Research unit : Échanges Eau–Sol–Plantes (Water–Soil–Plant Exchanges)

Abstract :

Floodplains are very heterogeneous environments in terms of land use, texture and variability in mineral and organic soil layers. These ecosystems also have great potential for soil carbon (C) storage due to their high moisture content, which slows down the mineralization of soil organic carbon (SOC). Since the 20th century, artificial drainage has reduced C concentrations in poorly drained soils in Belgium. Restoring SOC levels in floodplain environments is therefore critical, and rewetting is one of the strategies explored in the national RECARBON project. However, the role of land use management in SOC stabilization processes remains poorly understood.

This study investigates the combined impact of land use and drainage on SOC stability in the Belgian Dyle Valley.

Three zones were selected: freely drained, waterlogged, and intermediate drainage soils. Within each zone, land use types included forest, permanent grassland, and cropland or marsh. Soil samples were collected in three depths (0–10, 10–20, and 20–30 cm). In situ soil CO2 efflux was measured biweekly over one year, and CH4 efflux was monitored for four months. SOC stabilization mechanisms were explored through Zimmerman's fractionation procedure to assess physical C protection, and by analyzing thermal C stability using differential scanning calorimetry (DSC).

Preliminary results show that basal respiration at 10°C is lower in poorly drained soils compared to freely drained soils across all land uses (forest, grassland, and cropland). Additionally, the temperature sensitivity of CO2 respiration is significantly higher in poorly drained forest and cropland soils than in their freely drained counterparts. Humidity (i.e., as correlated with the water table) and temperature play crucial roles in predicting both greenhouse gases. Ongoing analyses focus on the role of physical protection via mineral associations and thermal stabilization under high temperatures to elucidate SOC stabilization processes.

Keywords : Floodplain, Soil Organic Carbon, Stability, Co2 Efflux, Environment Restoration

Large-Scale Farming Enhances Soil Health Contrasting With Conventional Management Of Smallholders: Insights From A Field Survey

Authors : Xin LI, Dong WU, Yaping HUANG, Xiao YANG, Gilles COLINET, Caroline DE CLERCK, Wenju ZHANG, Minggang XU, and Jeroen MEERSMANS

Email address : xin.li@student.uliege.be

Research unit : Échanges Eau–Sol–Plantes (Water–Soil–Plant Exchanges)

Abstract :

As an effective approach to achieving sustainable utilization of arable land resources, large-scale farming has been promoted to improve agricultural production efficiency and economic benefits with intensive advanced management practices. However, further evaluation is needed to determine whether large-scale farming can effectively improve soil health without increasing soil contamination. Soil health under large-scale farming was compared with smallholder management with 39 physical, chemical, biological, and environmental indicators. Large-scale farms under the commercial organic compost application and conventional fields in southeastern China were chosen in the field survey. Results showed that aggregate stability, soil organic matter (OM), available nutrients, and microbial biomass under large-scale management were significantly higher. Large-scale farming with organic compost altered microbial community and structure with a higher ratio of Fungi to Bacteria (F/B) and a lower ratio of Gram-positive bacteria to Gram-positive bacteria (G+ /G-). The soil fertility index and biological index were respectively 36.5% and 24.2% higher in large-scale farms than in conventional fields. However, there was no significant difference in soil environmental indices between the two management modes. Edaphic indicators of bulk density, penetration resistance, mean weight diameter, soil OM, DOC, earthworm biomass, gram-negative bacteria, and bacteria were identified by network analysis as key indicators of soil health assessment. The soil health index based on these indicators of large-scale farming was 23.4% higher than that of conventional management by smallholders, with higher structural stability, total and active organic carbon, and quantities of soil fauna and microorganisms. Similarly, the farmland quality index and soil health index based on all indicators under large-scale management were respectively 4.2% and 38.3% higher than those under conventional management. Overall, large-scale farming was cost-effective in enhancing soil health by improving soil fertility and microbial biomass without increasing soil pollution risks with specific commercial organic compost. This emphasized the advantages of large-scale farming in sustainable agriculture production through organic inputs.

Keywords : Soil Function, Minimum Data Set, Soil Organic Carbon, Microbial Community, Earthworms

Impact Of Biopesticides On Soil Microbial Communities

Authors : Maria Osipenko, Elise Lhoste, Thomas Demortier, Haissam Jijakli, and Caroline De Clerck

Email address : mosipenko@uliege.be

Research unit : Gestion durable des bio-agresseur (Sustainable management of bio-agressors)

Abstract :

The biologicals market is rapidly expanding, with biopesticides products leading at a 13.6% of compound annual growth rate (CAGR), followed by biofertilizers (12.5% CAGR) and biostimulants (12.0% CAGR). Despite their natural origin, limited research exists on their environmental fate and ecotoxicological effects on non-target organisms. The European X-Tree project introduces a sustainable cultural itinerary for Christmas tree production, developing a bio-based solution that integrates a bioherbicide, derived from essential oils to reduce weed competition, and a biostimulant, derived from plant extracts to promote tree growth. My PhD research takes part in this project and aims to evaluate the ecotoxicological impact of these products on soil microbiota. Given the fact that microbial ecotoxicology represents an emerging discipline, there is a lack for standardized methods to assess the soil microbial toxicity of environmental pollutants. At Gembloux Agro-Bio Tech (Liege University), various tools are available to characterize microbial responses at di]erent biological levels, including abundance, diversity, and activity, following exposure to pollutants and their transformation products. During my PhD, ecotoxicological experiments on soil are conducted in laboratory, greenhouse, and field settings, using biochemical assays (soil respiration and enzymatic tests), molecular biology techniques (sequencing, qPCR), and chemical analyses (chromatography). The impact of the products is evaluated both with and without adjuvants over a 30-day period following application. It is crucial to evaluate the risks of biopesticides to ensure they are less harmful to the environment than synthetic pesticides, as their e]ects can sometimes be comparable, highlighting the importance of ecotoxicological assessments before considering them as "safe alternatives".

Keywords : Microbial Ecotoxicity, Soil Microorganisms, Biological Herbicides, Biostimulants, Soil Pollution

Sediments Pathways To Small Rivers In Loamy Agricultural Region And Where To Find Them

Authors : Emilie Peiffer, Adrien Michez, and Aurore Degré

Email address : emilie.peiffer@uliege.be

Research unit : Échanges Eau–Sol–Plantes (Water–Soil–Plant Exchanges)

Abstract :

Fine sediments cause a wide range of damages to rivers. Sediments come from bank erosion and catchment erosion. Tackling erosion in small agricultural river catchments is essential because this part of the landscape is the sediment production zone. Analysis of catchments area is crucial because river ecosystems are closely linked to their watershed and its land use. This research focuses on the riparian zone associated with small downstream (semi)-permanent rivers (catchments > 1 km2). Indeed, these small rivers are where the characteristics of the riparian zone exert a strong control on the aquatic environment, notably by filtering sediments.

The objectives of this research are: i) to locate small agricultural catchments prone to sediment transfer to the river, ii) to understand how riparian zones can control this transfer.

We conducted our analysis in the erosion-prone loess region of Wallonia, where agriculture covers about 65% of the surface. To identify sites of sediment transfer in this region, catchments areas of at least 0.2 km2 with an outlet in smallrivers are drawn. To describe the erosion, soil type, slope, land use and agricultural background are analysed for each catchment. The intensity with which the crop can favour sediment production is evaluated based on crop history, with a focus on erosion-prone crops (maize, sugar beet or potatoes). The riparian zone at the outlet of these catchments is described using its width, height, composition and continuity, combined with the height above nearest drainage, the size of the downward river, and the angle at which the concentrated flow enters the river. Sediment deposition signal at the outlet is investigated using the difference between two DEMs.

We expect the catchment characteristics to determine the intensity of the deposition. We also link the physical parameters of the riparian zone to its sediment filtering ecosystem service.

Keywords : Catchment, Erosion, Landscape, Riparian Zone, River Ecolog

Soldiers Of The Deep: Using Volatile Organic Compounds And Entomopathogenic Nematodes To Control Wireworms.

Authors : Andrea Chacon-Hurtado and François J. Verheggen

Email address : achacon@uliege.be

Research unit : Ingénierie des productions animales et nutrition (Animal Sciences)

Abstract :

Wireworms (Coleoptera: Elateridae) are generalist insect pests attacking a wide range of plants, causing significant damages in agriculture. They feed on seeds, roots or crown and are particularly impactful on young seedlings. Wireworms locate their hosts using different cues including Volatiles Organic Compounds (VOCs) released in the rhizosphere and guiding the larvae to an appropriate host. One of the key challenges in managing wireworm infestations is their robust physical and immunological defenses, which protect them from pathogenic microorganisms, making effective control difficult. In this study, we aimed at developing an Attract-and-kill strategy by setting up two distinct objectives: (1) the selection of entomopathogenic nematode (EPNs) species that readily infects and kills wireworms and combining it with attractive odors (2).

We collected and compared the virulence of 16 EPNs populations, of foreign origin, purchased or collected from wireworms infested fields in Wallonia region. These results were related to symbiotic bacteria and morphometric characteristics of each EPN population. Mortality rates scaled from three to 43 % after 56 days of continuous exposure across the 16 tested EPN populations (Heterorhabditis spp. and Steinernema spp.). The strain H. atacamensis UCH 33043 was highly effective in killing wireworms (43 % of mortality). The symbiotic bacteria belong to the species were Photorhabdus antumapuensis, P. laumondii subsp. laumondii, P. thracensis, Xenorhabdus bovienii and X. nematophila. Morphometric analysis of IJs revealed both intra- and interspecific variations in length and diameter among populations. We found leaner IJs (< 25 µm) to induce higher mortality rates. Plant natural extracts were encapsulated in alginate beads and were shown to attract up to 90% of the tested wireworms, during behavioral assays performed in two-way olfactometers.

The encapsulation of natural extracts in alginate beads appears to be a promising lure to manipulate wireworms behavior, while the co-encapsulation with entomopathogenic nematodes remains the major challenge for the development of a new Attract-and-kill strategy.

Keywords : Click Beetle, Belowground Phytophagous Insects, Biocontrol, Integrate Pest Management, Gas Chromatography-Mass Spectrometry (GC-MS)

Development Of Bioherbicides Combining Essential Oils And Organic Acids

Authors : Nicolas Mathot, Hary Razafindralambo, and M. Haïssam Jijakli

Email address : nicolas.mathot@uliege.be

Research unit : Gestion durable des bio-agresseur (Sustainable management of bio-agressors)

Abstract :

As part of the European Conserwa project (https://conserwa.eu), which aims to promote weed management strategies aligned with agroecological principles, the University of Liège is developing an innovative bioherbicide for integration into alternative practices to chemical herbicides. This approach focuses on the synergistic combination of volatile aromatic compounds derived from essential oils (monoterpenes and phenylpropanoids) with organic acids, either in their pure form (e.g., acetic, lactic, or citric acid) or through lactic acid bacterial fermentates. This strategy has the potential to reduce the required concentrations of essential oils to achieve optimal herbicidal efficacy while simultaneously valorizing agricultural by-products through bacterial fermentation.

The aromatic compounds were selected based on their documented herbicidal potential, as reported in the literature. Their efficacy was assessed through in vitro germination assays and post-emergence tests on *Lolium perenne*. Following these results, the combinations of promising compounds and organic acids were evaluated to identify potential synergistic interactions. Finally, a *Lactobacillus plantarum* strain was selected for its capacity to produce high levels of organic acids and integrated into a formulation, enabling an innovative association of bacterial fermentates with essential oils. Initial results demonstrated some effective combinations, while further investigations are underway to better characterize the potential synergies among specific compounds.

Keywords : Bioherbicide, Essential Oils, Organic Acids, *Lactobacillus Plantarum*, Synbiotic

Efficacy Of Entomopathogenic Fungi Against *Bruchus Rufimanus* In Laboratory And Field Trials Using Dropleg Spraying Technique

Authors : Adrien Rodrigue Lugendo, Ibtissem Ben Fekih, Rudy Caparros Megido, Jérôme Pierreux, Frederic Francis and Arnaud Segers*

Email address : arlugendo@doct.uliege.be

Research unit : Gestion durable des bio-agresseur (Sustainable management of bio-agressors)

Abstract :

Biopesticides based on entomopathogenic fungi (EPF) offer promising alternatives to neurotoxic insecticides in pest control. Their potential has been evaluated against pests such as the bean weevil (Bruchus rufimanus), a major threat to faba bean (Vicia faba).

This study evaluated the lethal and sublethal effects of Beauveria bassiana (GHA), Metarhizium brunneum USDA 4556 and V275 strains on B. rufimanus adults under laboratory conditions. A field trial also examined the efficacy of B. bassiana (GHA) against B. rufimanus infestation using conventional drift and droplet spray methods.

Laboratory tests evaluated the effects of three fungal strains, the insecticide λ-cyhalothrin (400 µl/l) and Tween 80 (0.05%) on 600 sexed adults of B. rufimanus . TL_{50} and mortality were measured over 10 days (on 300 adults), and oviposition inhibition over 14 days (300 adults). In the field, dropleg and anti-drift spraying techniques were compared on spray distribution on basal and upper plant levels and the efficacy of B. bassiana and λ-cyhalothrin against seed infestations in field.

In laboratory tests, LT_{50} values varied from 4 days for B. bassiana to 8 days for M. brunneum (V275), with mortality rates between 86.6% and 96.6%. Oviposition inhibition varied from 12% (M. brunneum USDA 4556) to 36% (B. bassiana). Field results showed that drop-legged nozzles targeted pods more effectively, but reduced infestations by only 7% to 14%. These results underline the potential of EPF while highlighting the need for targeted methods such as attract-and-infect or endophytic EPF strategies.

Keywords : Biopesticide, Bruchids, Microbial Control, Faba Bean.

Multi-Faced Approaches On Wireworm Management: Feeding Preferences And Fatal Fungi

Authors : Fanny Ruhland, Andrea Chacon Hurtado, Ismahen Lalaymia, Antoine Boullis, Nolan Regnier, Stéphane Declerck, and François J. Verheggen

Email address : fanny.ruhland@uliege.be

Research unit : Gestion durable des bio-agresseur (Sustainable management of bio-agressors)

Abstract :

Wireworms are major agricultural pests worldwide, causing significant economic losses. With the recent ban on neonicotinoids, there is an urgent need for integrated management strategies using effective biocontrol solutions. In this study, we assessed (i) the feeding preferences of wireworm to different potato varieties and (ii) various entomopathogenic fungus strains as potential wireworm biocides. Three potato varieties experiencing contrasted field susceptibility to wireworm damage were assessed: Monalisa (high susceptibility), Spunta (moderate susceptibility), and Charlotte (low susceptibility). Wireworms exhibited higher feeding activity and an accelerated life cycle on Monalisa tubers compared to Charlotte, during laboratory bioassays. While Monalisa experienced the highest levels of damage, Spunta was the most attractive variety to wireworms. Using gas chromatography, we identified 63 volatile organic compounds released by tubers, but no significant differences were observed across varieties. These findings suggest that higher damage on Monalisa may be driven by enhanced foraging activity rather than attraction, possibly due to other olfactory cues such as CO2 or secondary metabolites. In parallel, we tested the biocidal activity of 13 strains of entomopathogenic fungi against wireworms. Two new strains showed significant efficacy after 12 weeks of exposure. The two most effective strains were then encapsulated in a biodegradable matrix optimized for field application. One strain demonstrates high wireworm mortality when encapsulated after eight weeks of exposure. These results provide novel insights into the complex interactions between wireworms and their hosts, while highlighting the potential of entomopathogenic fungi as sustainable biocontrol tools.

Keywords : Agriotes, Attractivity, Semiochemicals, Entomopathogenic Fungi, Virulence

Diversification Strategies To Conserve *Harmonia Axyridis* Towards Biological Control

Authors : Séverin Hatt, Xiaoling Tan, Frédéric Francis, Long Yang, Grégoire Noël, Naoya Osawa, Yunfei Pan, Arnaud Segers, Su Wang, and Qingxuan Xu

Email address : qingxuan.xu@uliege.be

Research unit : Biodiversité et Paysage (Biodiversity ecology and Landscape)

Abstract :

The ladybird beetle *Harmonia axyridis* Pallas (Coleoptera: Coccinellidae) is a predator of various insects, among which many are crop pests. Native from Northeast Asia, it was introduced into many countries for controlling aphids. Its subsequent spread in Europe, Africa, and America rose great concerns related to its negative impact on native coccinellid species through competition for prey and habitats, and intraguild predation. Yet, eradicating *H. axyridis* from its invaded regions appears to be impossible. Exploiting its positive predatory behaviour to control crop pests, while managing its negative impact on associated biodiversity is, probably, the only possible compromise. The solution may lie in increasing plant diversity and enhancing habitat structural complexity. Multiplying ecological niches can offer refuges and more food resources for predators, sustaining natural enemy diversity while reducing their interference. Hence, diversifying agroecosystems could favour the biocontrol potential of *H. axyridis* in general and make it an ally rather than a foe in its invaded regions. The review analyses the ecology and biocontrol potential of *H. axyridis* in the landscape by considering the effect of its heterogeneity and fragmentation; examines the effects of farm-scale diversification practices on the ladybird species including annual crop successions and mixtures, companion planting in perennial systems, non-crop habitats at field margins, and insectary and banker plants in greenhouses, offering an original overview of the plant species benefiting to *H. axyridis* in heterogeneous agroecosystems; to finally discuss the role of plant diversity in the making of *H. axyridis* as a partner more than a threat.

Keywords : Coccinellidae, Conservation Biological Control, Landscape Management, Mixed Cropping, Multicolored Asian Lady Beetle

Optimized Ultrasonic-Assisted Extraction Of Bioactive Compounds From *Laurus Nobilis, Rosmarinus Officinalis, Pimpinella Anisum* And Their Combinations

Authors : Yosra Bannour, Ibtissem Hamrouni, Mohamed Ali Ayadi

Email address : yosra.bannour@doct.uliege.be

Research unit : Ingénierie des productions végétales et valorisation (Plant Sciences)

Abstract :

The aromatic and medicinal plants Laurus nobilis (*L., Lauraceae*), Rosmarinus officinalis (*R., Lamiaceae*), and Pimpinella anisum (*L., Apiaceae*) are recognized for their diverse biological activities, attributed to their rich bioactive compound profiles. Using a Response Surface Methodology (RSM) approach, this study aimed to:

- Optimize ultrasonic-assisted extraction parameters for phenolic compounds.
- Testing antioxidant activity of these extracted phenolic compounds using DPPH tests.
- Evaluate the potential synergistic interactions among these extracted compounds.

The methodologies included: (1) A four-factor, three-level Box-Behnken Design (BBD) assessing the effects of extraction temperature (X1), maceration time (X2), ultrasonic power (X3), and ethanol concentration (X4) on phenolic content and antioxidant activity, and (2) an augmented simplex centroid design to determine the synergistic combinations of these plants.

Our results indicate: (1) Optimal extraction conditions for *L. nobilis* were 75°C, 56 minutes, 74% ultrasonic power, and 4% ethanol, yielding the highest total polyphenolic content (TPC), flavonoid content (TFC), condensed tannins content (CTC), and DPPH radical scavenging activity. For *R. officinalis*, the optimal conditions were 25°C, 51 minutes, 89% ultrasonic power, and 17% ethanol. For *P. anisum*, 50°C, 20 minutes, 60% ultrasonic power, and 10% ethanol were optimal for TPC, TFC, and DPPH activity.

(2) Using the desirability function from the mixture design, the optimal combination of 64.9% *P. anisum*, 13.8% *R. officinalis*, and 21.3% *L. nobilis* achieved the highest TPC, TFC, and DPPH activity, demonstrating the synergistic potential of these plants.

Keywords : Optimization, Phenolic Compounds, Antioxydant Activity, Laurus Nobilis, Rosmarinus Officinalis, Pimpinella Anisum, Mixture.

Advances In Protein Extraction Methods From Faba Bean

Authors : Mariem Boukraa, Nicolas Jacquet, and Christophe Blecker

Email address : mariem.boukraa@uliege.be

Research unit : Technologies alimentaires (Food Technology)

Abstract :

Faba beans (*Vicia faba L.*) are a promising source of sustainable plant-based protein due to their high protein content, nutritional value, and environmental benefits. However, challenges such as anti-nutritional factors (ANFs), limited scalability, and the need to preserve protein functionality hinder their efficient utilization in food systems.

This work aims to evaluate dry, wet, and hybrid protein extraction methods and pretreatments, focusing on their impact on protein yield, purity, functionality, scalability, and environmental sustainability. It identifies advancements and research gaps to inform future developments and promote industrial applications.

A comprehensive analysis of existing literature was conducted, exploring pretreatment techniques such as dehulling, soaking, germination, and fermentation. Extraction methods, including dry, wet, and hybrid approaches, were compared for efficiency in reducing ANFs, improving protein quality, and scalability. Emerging techniques, such as using deep eutectic solvents (DES) and ultrasound-assisted processes, were also evaluated for their potential.

Dry methods (e.g., air-classification) preserve protein structure, offer cost-effective and environmentally sustainable solutions, but often yield lower protein purity and concentrate ANFs in protein-rich fractions, limiting their direct application in food systems. Wet methods (e.g., alkaline extraction followed by isoelectric precipitation) achieve high protein purity and functionality, making them suitable for refined food applications, but they are resource-intensive. Hybrid approaches combine the strengths of dry and wet methods, achieving high protein yield and purity while reducing resource consumption. Pretreatments can enhance extraction efficiency, reduce ANFs, and improve nutritional and functional properties.

Dry methods (e.g., air-classification) preserve protein structure, offer cost-effective and environmentally sustainable solutions, but often yield lower protein purity and concentrate ANFs in protein-rich fractions, limiting their direct application in food systems. Wet methods (e.g., alkaline extraction followed by isoelectric precipitation) achieve high protein purity and functionality, making them suitable for refined food applications, but they are resource-intensive. Hybrid approaches combine the strengths of dry and wet methods, achieving high protein yield and purity while reducing resource consumption. Pretreatments can enhance extraction efficiency, reduce ANFs, and improve nutritional and functional properties.

Keywords : Faba Bean, Vicia Faba L., Protein Extraction, Pretreatment, Plant-Based Protein

Formate From THF-C1 Metabolism Induces The *AOX1* Promoter In Formate Dehydrogenase-Deficient *Komagataella Phaffii*

Authors : Cristina Bustos, Julio Berrios, and Patrick Fickers

Email address : cvbustos@uliege.be

Research unit : Microbial technologies

Abstract :

In *Komagataella phaffii* (*Pichia pastoris*), formate is a recognized alternative inducer to methanol for expression systems based on the *AOX1* promoter (p*AOX1*). By disrupting the formate dehydrogenase encoding *FDH1* gene, we converted such a system into a self-induced one, as adding any inducer in the culture medium is no longer requested for p*AOX1* induction. In cells, formate is generated from serine through the THF-C1 metabolism, and it cannot be converted into carbon dioxide in a FdhKO strain. Under non-repressive culture conditions, such as on sorbitol, the intracellular formate generated from the THF-C1 metabolism is sufficient to induce pAOX1 and initiate protein synthesis. This was evidenced for two model proteins, namely intracellular eGFP and secreted CalB lipase from *C. antarctica*. Similar protein productivities were obtained for a FdhKO strain on sorbitol and a non-disrupted strain on sorbitol-methanol. Considering a *K. Phaffii* FdhKO strain as a workhorse for recombinant protein synthesis paves the way for the further development of methanol-free processes in *K. phaffii.*

Keywords : Pichia Pastoris, Komagataella Phaffii, Formate, Gene Modification

Evaluation Of Rheology And Printability Of Starch-Chitosan-Gluten Hydrogel: First Approach And Perspectives

Authors : De Roover Quentin, Richel Aurore, and Haubruge Eric

Email address : quentin.deroover@uliege.be

Research unit : Chimie des agro-biosystèmes (Chemistry for Sustainable Food and Environmental Systems)

Abstract :

Biodegradable starch-based hydrogels present effective alternatives to traditional wound dressing or transdermal patch technologies. This study evaluated the rheological properties of a starch-chitosan hydrogel enriched with gluten to develop an ink suitable for 3D printing, specifically for Direct Ink Writing (DIW). Initial viscosity tests and viscoelastic behavior analysis were conducted using an Anton Paar rheometer. Hysteresis, amplitude sweep, and frequency sweep measurements were performed to further investigate the gel's rheological properties. The results revealed that the gel exhibits shear-thinning behavior with a structural recovery of 88%, as evidenced by hysteresis tests. Amplitude sweep tests demonstrated an increase in the linear viscoelastic region (LVE-R) with higher gluten content, while frequency sweep tests confirmed a predominantly elastic behavior (tan $\delta < 1$) in all gels. DIW printing tests validated the hydrogel's ability to maintain its 3D-printed structure. Although the tested hydrogels displayed generally favorable rheological properties for 3D printing, further optimization is needed to achieve ideal performance. This study underscores the potential of these hydrogels as matrices for incorporating active compounds, paving the way for novel biomedical applications.

Keywords : Starch-Based Hydrogel, Rheological Properties, Direct Ink Writing (DIW), 3D Printing, Biomedical Applications

Development Of A Fluorescent Biosensor For Monitoring Protein Secretion At A Single-Cell Level

Authors : Mélanie Grégoire, Frank Delvigne, and Francesco Renzi

Email address : m.gregoire@uliege.be

Research unit : Microbial technologies

Abstract :

Cell-to-cell heterogeneity presents challenges across various fields, from biomedicine to bioproduction, particularly when precise cellular responses are required. While single-cell analysis has advanced our understanding of population heterogeneity and strategies to manage it, current methodologies primarily target intracellular compounds. Given the critical role of extracellular products in bioengineering, there is an urgent need to extend single-cell approaches to characterize and regulate heterogeneity in the production of secretory proteins and compounds (Hartmann FSF, Grégoire M, Renzi F, Delvigne F. Single cell technologies for monitoring protein secretion heterogeneity. Trends Biotechnol. Published online 2024:1-17. doi:10.1016/j.tibtech.2024.02.011).

Typically, the analysis of secretory proteins relies on bulk measurements (e.g., supernatant analysis), which average the behavior of a cell population and obscure insights into heterogeneity at the single-cell level. As secretory pathways become biologically complex, distinct sources of noise can influence protein secretion, emphasizing the need for single-cell resolution studies.

Using *Bacillus subtilis* as a model organism renowned for its secretion potential, this study investigates the functional stages of protein secretion and identifies potential noise sources, given its industrial relevance and well-characterized secretion pathways. A key initial step involves identifying effective biosensors for monitoring single-cell secretion in technologies such as segregostat and microfluidics.

Two strategies are under evaluation. The first involves real-time monitoring of secretion by detecting fluorescence from properly folded fluorescent proteins in the membrane. The second tracks stress induced by protein secretion, using stress-responsive promoters that trigger intracellular fluorescence, correlating stress levels with fluorescence intensity.

These biosensors will enable the tracking of secretion for both fluorescent proteins and proteins fused to targeted secretory compounds. In the next phase, these tools will be applied to produce various recombinant proteins exhibiting different levels of secretion stress. Real-time control of secretion stress will be enabled based on our Segregostat technology i.e., automated flow cytometry with feedback control for directing cell population. This approach will allow the characterization and the control of protein secretion at single-cell level across different functional stages, addressing heterogeneity and improving bioproduction processes.

Keywords : Heterogeneity, Biosensor, Secretion

Antisense Transcription Mediates Oncogenesis Of Bovine Leukemia Virus.

Authors : Jouant Thomas, Joris Thomas, Jacques Jean-Rock, Zhang Yunhang, Ren Mei, and Willems Luc

Email address : thomas.jouant@doct.uliege.be

Research unit : Microbial technologies

Abstract :

Bovine Leukaemia Virus (BLV) is the agent responsible for a proliferative disease that targets B-lymphocytes in cattle. The disease typically manifests as persistent lymphocytosis and, in some cases, progresses to leukaemia after a prolonged latency period of 4–10 years. The BLV provirus transcribes a series of non-coding RNAs that remain undetected by the host immune response. Specifically, three RNAs (AS1-L, AS1-S, and AS2) are consistently expressed from the antisense strand, originating from transcriptional initiation at the 3'-Long Terminal Repeat (LTR).

Although antisense RNAs have been considered as non-coding, AS1-L contains a small open reading frame (ORF). This study aims to determine whether this ORF is translated into a polypeptide and explores its role in viral replication and pathogenesis.

A fusion protein between the ORF and the Nano-Glo luciferase was expressed in eukaryotic cells. After lysis, the fusion protein was immunoprecipitated with sera from BLV-infected animals. Luciferase assays revealed the presence of anti-ORF antibodies. To investigate the role of this antisense ORF in viral replication, the initiation codon was mutated in a BLV molecular clone. Simultaneously, antisense transcription was reduced by introducing a mutation in the 3'-LTR promoter. Infectivity in vitro was evaluated by co- cultures with OVK-LTR-luciferase reporter cells. These mutations were designed to minimally impact sense transcription. After inoculation into sheep, the proviral loads were determined by qPCR.

The presence of anti-ORF antibodies in the sera of infected animals supported the relevance of the polypeptide in vivo. The proviruses mutated in the antisense ORF were infectious in cell cultures and sheep. However, reduction of antisense transcription and mutation of the initiation codon affected BLV replication in sheep. Ongoing experiments will further characterize the pathogenic role of the mutated proviruses.

Keywords : BLV, Antisens, Oncogenèse

Metabolomic Analysis Revealed Structural Diversity Of Pectic Polysaccharides From Peach And Structure-Property Relationship Between Pectin And Purees

Authors : Meng Liu, Jinfeng Bi*, Song Yan, Shaojie Fu, Qianhai Yang, Christophe Blecker, and Xuan Liu**

Email address : meng.liu@student.uliege.be

Research unit : Technologies alimentaires (Food Technology)

Abstract :

The metabolism and reassembly of pectin were closely bound up with its level and structure determining fruit quality traits in the mature peach. Nevertheless, there remains a dearth of adequate information regarding the mechanism of pectin from biosynthesis to processed products. This research focused on analyzing the structural features of pectin fractions (sequentially extracted by water, chelate, and sodium carbonate, namely water-soluble pectin (WSP), chelate-soluble pectin (CSP), sodium carbonate-soluble pectin (SSP), respectively), physicochemical and rheological properties of purees, and metabolomics among 20 peach varieties with juicy, distinct viscosity, turbidity, and color features. Multivariate statistics analysis was applied to elucidate significant differences of these varieties based on the structure of pectin factions from the perspective of metabolome. The results showed four groups were divided according to 12 key structural features of pectin. Metabolome revealed a total of 12 core metabolites (saccharides, organic acids and phenolic compounds), among which 8 were highly related to the yield of CSP. Notably, higher homogalacturonan (HG) and galacturonic acid (GalA) contents in CSP could largely be responsible for the distinct accumulation of homocitrate, inositol, D-galactose, and D-mannose. Correlation analysis showed there was a positive significant relationship between backbone and side chain of CSP and rheological property of purees. Meanwhile, higher expression in taxifolin and phlorizin chalcone which probably be associated with the accumulation of pigments generating to various color of purees. This study offered theoretical backing for reinforcing quality improvement of purees and breeding nutrition-improved varieties in peach fruit.

Keywords : Peach Pectin, Purees, Metabolome, Structural Diversity, Correlation

Response Surface Methodology Optimization Of Alkaline Extraction Of Polysaccharides From Rapeseed Meal: Characterization And In Vitro Antioxidant Activity

Authors : Xiaoxian Liu, Jin Xie, Nicolas Jacquet * and Christophe Blecker *

Email address : xiaoxian.liu@doct.uliege.com

Research unit : Technologies alimentaires (Food Technology)

Abstract :

An essential agricultural by-product of rapeseed is rapeseed meal, this meal is characterized by its abundance of bioactive natural polysaccharides. Natural polysaccharides possess various biological activities, such as antioxidant and hypoglycemic effects. Moreover, they are biodegradable, non-toxic, and biocompatible. Unfortunately, due to RSM being primarily used in animal feed, rapeseed meal polysaccharides (RMP) have not been thoroughly studied.

The study investigates the optimal extraction conditions of RMP and examines its structural characteristics and antioxidant properties. The research utilizes a Box-Behnken design for optimization. Gas chromatography, particle size and zeta-potential analysis, thermal gravimetric analysis, and Fourier-transformed infrared spectroscopy are employed. Antioxidant properties are evaluated using ABTS radical scavenging activity and DPPH radical scavenging activity assays.

The optimal conditions for extracting RMP are temperature 65°C, NaOH concentration 0.086g/ml, and time 5.17 hours. Under these optimal hydrolysis conditions, the model predicted RMP yield is 23.30%, and the actual yield was verified to be 23.10%. The variable with the greatest impact on the response was the time (h). Significant differences were observed between RMP extracted under non-optimal conditions and RMP (optimal conditions) in terms of extraction yield, monosaccharide composition, structural characteristics, and antioxidant activity. Shorter extraction times and milder extraction conditions generally resulted in lower extraction yields but produced polysaccharides with higher galacturonic acid content, lower molecular weight, and stronger antioxidant activity. In contrast, longer extraction times or more intense extraction conditions led to the reassembly of some free polysaccharides, resulting in stronger intermolecular interactions, higher thermal stability, and larger particle sizes of the products.

Keywords : Rapeseed Meal, Response Surface Methodology, Polysaccharides, Structural Characterization, Vitro Antioxidant Activity

Callus Induction And Characterization Of Volatile Compounds In *Capparis Spinosa*

Authors : Marouane Mohaddab, Manon Genva, Clément Burgeon, Malika Fakiri, Younes El-Goumi, and Marie-Laure Fauconnier

Email address : mmohaddab@uliege.be

Research unit : Chimie des agro-biosystèmes (Chemistry for Sustainable Food and Environmental Systems)

Abstract :

Caper (*Capparis spinosa L.*) is a well-established medicinal plant in the Mediterranean region, renowned for its medicinal, pharmacological and culinary properties. Several bioactive phytochemical compounds have been isolated and identified from the various parts of this plant, making it a valuable source of molecules for the pharmaceutical industry. Plant metabolites are also increasingly used in agronomy, due to their beneficial properties, such as insecticidal and herbicidal activity. However, the increasing use of these metabolites makes it necessary to optimize their production. The integration of biotechnological technologies, in particular *in vitro* culture systems, offers economic and environmental advantages for the sustainable production of these compounds.

Callus culture is an effective method for producing biologically active molecules from medicinal plants. Although the production of volatile compounds from *C. spinosa* using callus culture has not yet been studied, this approach could reduce the need to harvest all the plant material, while offering great potential for ensuring the sustainable production of these secondary metabolites.

In this context, the aim of this study was to induce callus formation from C. spinosa leaf explants grown on a medium enriched in two cytokinin's (kinetin and 6-benzylaminopurine) and two auxins (1-naphthaleneacetic acid and 2,4-dichlorophenoxyacetic acid). We explored various combinations of these phytohormones using response surface methodology (RSM), which enabled us to determine the optimum concentrations for biomass maximization, while evaluating the linear and quadratic effects of the hormones on growth. Next, we analyzed the volatile compounds present in the callus, comparing them with those of fresh leaves. The volatile profiles were characterized by gas chromatography-mass spectrometry (GC-MS) for each hormone combination, revealing significant variations in volatile components depending on the treatments applied. This study thus makes it possible to establish a metabolomic relationship between phytohormones and the production of these volatile compounds.

In parallel with the analysis of volatile compounds, this study focused on the non-volatile secondary metabolites of *C. spinosa* callus, such as flavonoids and phenols, which are essential to the plant's pharmacological and biological properties. Current research aims to identify and quantify these molecules using techniques such as liquid chromatography and mass spectrometry (LC-MS).

These results offer promising prospects for the sustainable industrial production of secondary metabolites. They also pave the way for scaling up suspension cultures by optimising culture parameters to obtain constant yields. By simultaneously analysing volatile and non-volatile compounds, this research provides a comprehensive metabolomic characterisation of *C. spinosa* callus, laying the foundations for large-scale suspension culture systems and future biotechnological applications.

Keywords : Capparis Spinosa, Callogenesis, Phytohormones, Volatile Organic Compounds.

Inhibiting HTLV-1 Transmission By Impairing Extracellular Vesicle PDZ Interactome

Authors : Sibusiso B. Maseko, Jedidja Puttemans, Yasmine Bramerloo, Karim Blibek, Jeremy Blavier, Thandokuhle Ntombela, Inge Van Molle, Julie Joseph, Julien Olivet, Deeya Saha, Manon Degey, Malik Hamaidia Pooja Jain, Piel Geraldine, Pascale Zimmermann, Dae-Kyum Kim, Dominique Baiwir, Luc Willems, Makon-Sébastien Njock, Franck Dequiedt, Kourosh Salehi-Ashtiani, Steven Ballet, Alexander N. Volkov*, and Jean-Claude Twizere*

Email address : jputtemans@uliege.be

Research unit : Microbial technologies

Abstract :

Extracellular vesicles (EVs) are known to facilitate infection by enveloped RNA viruses including the Human T-cell leukemia virus type-1 (HTLV-1). HTLV-1-encoded proteins, such as the transactivator and oncoprotein Tax-1, are loaded into EVs but their precise impact on EV cargos is not yet known. Here, we report a comprehensive interaction map between Tax-1 and the human PDZ (PSD95/DLG/ZO-1) proteins that regulate EVs formation and composition. We show that Tax-1 interacts with more than one-third of hPDZome components, including proteins involved in cell cycle, cell-cell junctions, cytoskeleton organization, and membrane complex assembly. We extensively characterized Tax-1 interaction with syntenin-1, an evolutionary conserved PDZ hub that controls EV biogenesis. Using nuclear magnetic resonance (NMR) spectroscopy, we have determined the structural basis of the interaction between the C-terminal PDZ binding motif (PBM) of Tax-1, and the two PDZ domains of syntenin-1. Importantly, we show that a small molecule able to inhibit HTLV-1 cell-to-cell transmission breaks the Tax-1/syntenin-1 interaction, impacts the levels of syntenin-1 and viral proteins in EVs, and shifts the EV composition towards cellular antiviral proteins and microRNAs, including the miR-320 family. Consequently, our results suggest that mimics of miR-320c, encapsulated into EVs, have antiviral activities with a potential to be used against HTLV-1 induced diseases.

Keywords : Tax-1, PDZ, Interactome, Syntenin-1, Mirna

Optimization Of Lippia Alba Essential Oil Yield And Limonene Content Using Response Surface Methodology

Authors : Aissatou Sakho, Michel Bakar Diop, César Bassene, Serigne Mbacké Diop, Momar Talla Gueye, Clément Burgeon, Manon Genva, Fréderic Francis, And Marie-Laure Fauconnier

Email address : aissatou.sakho@student.uliege.be

Research unit : Chimie des agro-biosystèmes (Chemistry for Sustainable Food and Environmental Systems)

Abstract :

In Senegal, post-harvest losses of cereals and legumes remain high due to various factors, including insect infestations and mycotoxins. The excessive use of chemical pesticides to control pests in stored grains increases the risk of toxic residues in food and the environment. Consequently, the shift toward sustainable alternatives, such as active biomolecules particularly essential oils with larvicidal, insecticidal, and antifungal properties offer a promising solution to overcome these structural challenges and promote competitive, eco-friendly agriculture. The essential oil of *Lippia alba* holds significant potential for our research due to its insecticidal and fungicidal properties, as well as its adaptability to the agroecological conditions of Senegal.

This study focuses on optimizing *Lippia alba* essential oil yield and limonene content of while ensuring a stable and reproducible composition. A full factorial design was used to assess the combined effects of three factors: phenological stage, drying time, and distillation duration, on both yield and limonene content. The data were analyzed using response surface methodology (RSM). This provided a comprehensive understanding of the interactions between the variables and the optimization of essential oil yield and enabled further optimization. The findings of this study could contribute to improving the efficiency and sustainability of essential oil production in Senegal, with potential applications in pest control in pest control in stored cereals.

Keywords : Post-Harvest Losses, Essential Oils, Lippia Alba, Response Surface Methodology (RSM) (RSM)

Effects Of Sow And Piglet Protein Diets On The Ileum Transcriptome And Gut Development Of Piglets

Authors : Shize Xiao, Kikianne Kroeske, Marc Heyndrickx, Sam Millet, Nadia Everaert, and Martine Schroyen

Email address : sz.xiao@student.uliege.be

Research unit : Ingénierie des productions animales et nutrition (Animal Sciences)

Abstract :

Optimizing dietary protein levels during sow gestation and piglet rearing is critical for improving gut development, immunity, and metabolism in pigs. While these factors have been studied individually, their combined effects on the intestinal transcriptome remain poorly understood.

This study investigates the combined effects of sow dietary protein during gestation and piglet dietary protein pre- and post-weaning on ileum transcriptomic profiles, crypt depth, and gut development.

Sows were assigned to two dietary treatments during late gestation: high-protein (HP) or low-protein (LP). After birth, their piglets were grouped based on post-weaning dietary treatments, resulting in four groups: HH (sow HP + piglet HP), HL (sow HP + piglet LP), LH (sow LP + piglet HP), and LL (sow LP + piglet LP). Ileum samples were collected at 3.5 weeks (pre-weaning) and 4.5 weeks (post-weaning). RNA-seq data were analyzed using Weighted Gene Co-expression Network Analysis (WGCNA) to identify key gene modules associated with dietary protein levels and gut health indicators, including crypt depth and villus height. Functional enrichment analysis was performed on genes within the identified modules to explore biological processes (BP), KEGG pathways, and REAC pathways. Genes appearing in top- ranked pathways were further filtered using criteria of gene significance (GS > 0.5) and module membership (MM > 0.8). Predictive protein-protein interaction (PPI) analysis was conducted, and hub genes were visualized and identified using Cytoscape based on their connectivity within the network.

At 3.5 weeks, crypt depth was positively correlated with immune-related genes, with PARP9, PARP14, and IFIT1 identified as hub genes. At 4.5 weeks, low-protein diets increased stress response and nitrogen metabolism gene expression. Collagen metabolism genes were associated with crypt depth, suggesting their role in gut development. These findings highlight stage-specific transcriptomic responses to dietary protein levels.

Keywords : Maternal Dietary Protein, Piglet Ileum Transcriptome, Crypt Depth, WGCNA, Gut Development

Structure And Functional Properties Of Myosin Induced By Electrostatic Fields At Different Ph Values

Authors : Yuqian Xu, Martine Schroyen, Dequan Zhang, and Chengli Hou

Email address : yuqian.xu@student.uliege.be

Research unit : Ingénierie des productions animales et nutrition (Animal Sciences)

Abstract :

In this study, the effects of electrostatic field on myosin structure and function at different pH values were investigated. Myosin was selected as target protein to establish 10% v/v, 10 mg protein/mL myosin protein solution models (MYPs) at 4 different pH conditions (9.0, 7.0, 5.0, 3.0). The MYPs treated with and without the application of 12 kV high voltage electrostatic field (EF) for 6 h. The changes of secondary structure, microstructure, oxidation properties, texture properties and thermal processing properties of MYPs were comprehensively analyzed. The results demonstrated a higher surface hydrophobicity and lower sulfhydryl group content of the EF group compared to control group ($P < 0.05$). The particle size, secondary structure, and microstructure investigations revealed that the EF group had decreased protein aggregation and a more stable protein structure. Furthermore, the application of EF improved the water holding capacity of myosin gel by enhancing interaction between water molecules and protein, reducing the loss of free and immobilized water. In addition, the structure of the gel formed by EF was more stable, showing higher gel hardness and dense microstructure. The study further revealed that the internal mechanism of EF to maintain quality of fresh meat may be related to maintaining the structural and functional activity of myosin.

Keywords : Electrostatic Field, Myosin, Ph Value, Protein Structure, Protein Function.

Effect Of Plant Polyphenols With Different Structures On The Inhibition Of Heterocyclic Amines Formation In Roasted Meat

Authors : Xiaoyue Yang, Christophe Blecker, Huan Liu, Dequan Zhang*, and Zhenyu Wang*

Email address : xiaoyue.yang@doct.uliege.be

Research unit : Technologies alimentaires (Food Technology)

Abstract :

Heterocyclic amines (HAs), which are easily produced during high-temperature heating of protein-rich foods (such as meat and fish), have been widely concerned for their carcinogenic and mutagenic effects. The addition of polyphenols is an effective way to reduce the formation of HAs. To elucidate the regulation of different structures of polyphenolic compounds with m-hydroxy and o-hydroxy groups inhibiting the formation of different HAs, the reactions between classified polyphenols (cover flavonoids, phenolic acids, stilbenes, coumarins, chalcones, and with different hydroxyl groups) and roasted lamb patties were studied, and then validated in model systems in vitro. The results indicated that the chalcone, coumarin, and stilbene compounds were more efficient to inhibit the HAs generation in roasted lamb patties in comparison with the flavonoids, while phenolic acid had the worst effect. Besides, polyphenols inhibit the formation of HAs through a synergistic action of scavenging free radicals and trapping active carbonyls. Polyphenols with m-hydroxyl structures have a stronger inhibition of 2-amino-1-methyl-6-phenylimidazo[4,5-b]-pyridine (PhIP), 1-methyl-9H-pyrido[3,4-b]-indole (Harman) and 9H-pyrido[3,4-b]-indole (Norharman) by capturing the reaction intermediate carbonyl compounds. Polyphenols with the o- hydroxyl group had a stronger inhibitory effect on 2-amino-3,8-dimethylimidazo[4,5- 2 f]quinoxaline (MeIQx) by scavenging free radicals. It was concluded that the ability of polyphenols to inhibit different HAs can be predicted by their m-hydroxyl and o- hydroxyl groups.

Keywords : Heterocyclic Amines, Polyphenols, Reactive Carbonyls, Free Radicals

Dioecy Impacts The Chemical Profile And Antibacterial Activity Of Essential Oils From Leaves Of *Pistacia Lentiscus L.*

Authors : Mouna Belkessam, Manon Genva, Nada Souissi, Mohamed Dridi, Mossadok Ben-Attia and Marie-Laure Fauconnier

Email address : mouna.belkessam@doct.uliege.be

Research unit : Chimie des agro-biosystèmes (Chemistry for Sustainable Food and Environmental Systems)

Abstract :

Pistacia lentiscus L, commonly known as the mastic tree, is a dioecious plant of the Anacardiaceae family, widely used in Mediterranean traditional medicine for treating gastrointestinal, skin, and respiratory disorders. Although the medicinal properties of *P. lentiscus* L. have been extensively studied, the role of dioecy in influencing its chemical composition and antibacterial activity remains underexplored.

This study aimed to investigate the impact of dioecy on the chemical composition and antibacterial activity of essential oils extracted from the leaves of male and female *P. lentiscus* L. plants.

Essential oils were obtained by hydro-distillation from the leaves of male and female *Pistacia lentiscus* L. plants growing in northern Tunisia. Their various physicochemical and organoleptic characteristics were recorded in accordance with AFNOR standards and analyzed using gas chromatography coupled with mass spectrometry. Their antibacterial activity was assessed against ten bacterial strains.

The analysis revealed a predominance of non-oxygenated monoterpenes in all samples, with essential oils from female plants displaying greater molecular diversity. Antibacterial tests showed that essential oils from female plants were more effective against Gram-negative bacteria, particularly *Escherichia coli* and *Klebsiella pneumoniae*, while those from male plants were more active against *Staphylococcus aureus*.

These findings emphasize the influence of dioecy on the chemical composition and antibacterial properties of *P. lentiscus* L. essential oils, highlighting the potential for gender-specific selection of plants for targeted antibacterial applications.

Keywords : Antimicrobial Activity, Chemical Composition, Dioecy, Essential Oil, Pistacia Lentiscus L.

Molecular Network Mapping Of Anti-Plasmodial Biomolecules In *Dialium Lopense* Wood By-Products

Authors : Gaël Bibang Bengono, Olivier Bonnet, Jean-Louis Doucet, Robin Doucet, Michel Frederich, Aurore Richel, and Alain Souza

Email address : gael.bibangbengono@doct.uliege.be

Research unit : Gestion des Ressources forestières (Forest Resources Management)

Abstract :

In Central Africa, stricter timber quality standards on international markets have led to more selective legal logging, reducing the number of harvested species, including *Aucoumea klaineana*, which suffers from low regeneration capacity. Local sawmills often generate low yields, leaving by-products abandoned or burned in forests. However, some *Dialium* species show strong regeneration and possess promising wood properties, making them suitable for sustainable forest management and efficient resource utilization. Additionally, African trees are rich in secondary metabolites with significant bioactivity, presenting potential treatments for diseases like malaria, which continues to affect over 247 million people, especially in tropical Africa, where *Plasmodium falciparum* resistance to current treatments is rising. The urgent need for new bioactive compounds to counteract this resistance highlights the importance of exploring *Dialium* species, known to contain steroids, polyphenols, terpenoids, and flavonoids with antimalarial properties. Despite this potential, there is a notable research gap regarding the bioactive compounds in by-product residues of Dialium and other forest species. This study aims to address this gap by investigating the antiplasmodial compounds in hydroethanolic and dichloromethane extracts of *Dialium lopense* forest residues using a molecular network approach.

Keywords : Wood Management, Biomolecules, Alkaloïds, Antiplasmodium

Translocation And Metabolization Of Lemongrass And Cinnamon Essential Oils By Monocotyledons And Dicotyledons

Authors : A. Claeys, M. Deleu, M.-L. Fauconnier, and M. Genva

Email address : anais.claeys@uliege.be

Research unit : Chimie des agro-biosystèmes (Chemistry for Sustainable Food and Environmental Systems)

Abstract :

The widespread use of synthetic herbicides has raised concerns due to increasing weed resistance and risks to human health and the environment. In response, biosourced alternatives with multisite activity, such as essential oils (EOs), offer promising bioherbicidal potential. While Java lemongrass and Ceylon cinnamon EOs have been particularly highlighted for their herbicidal properties, the mechanisms of action of these EOs remain largely unknown. Indeed, an applied EO can either act locally at the application site or move through the vascular bundles of the plant, which is a process known as translocation. Additionally, plants have biochemical and physiological mechanisms that may partially or fully detoxify the compounds from the EOs, which can influence their overall effectiveness in the context of their use as bioherbicides. Understanding how these oils are translocated and metabolized in different plant species is therefore crucial for optimizing their use as bioherbicides.

This study aims to determine whether the major compounds of Ceylon cinnamon (Cinnamomum verum, from the bark) and Java lemongrass (Cymbopogon winterianus, from the aerial part of the plant) EOs are translocated, metabolized, and potentially detoxified by *Arabidopsis thaliana (L.)* Heynh. and *Lolium perenne L.* following foliar application.

GC-MS results revealed translocation of all compounds from treated to untreated leaves after five days. Translocation to the roots was also observed but could not be quantified. The enzyme assays carried out showed that *trans*-cinnamaldehyde was metabolized into cinnamic alcohol, potentially by cinnamyl alcohol dehydrogenase, to a greater extent in leaves than in roots. In contrast, the main constituents of lemongrass EOs do not appear to be modified by the enzymatic extract.

Keywords : Translocation, Metabolization, Essentials Oils

Low Oxygen Availability Favors Induction Of pAOX1 Promoter Of FdhKO Strains In The Yeast *Komagataella Phaffii*.

Authors : Cristina Bustos*, Rocio Cozmar, Julio Berrios, and Patrick Fickers

Email address : rc.cozmar@doct.uliege.be

Research unit : Microbial technologies

Abstract :

Komagataella phaffii, a widely recognized yeast strain utilized to produce recombinant proteins (rProt) is influenced by metabolic/operational factors. Previous reports have described the self-induced FdhKO strain, it assimilates sorbitol with high rProt-specific activity upon pAOX1 promoter induction by formate accumulation. However, its growth rate (μ) is low. *SOR1*, encoding sorbitol dehydrogenase (Sd), was overexpressed (SdOE) to increase the carbon source uptake. Although the μ of strain (FdhKO-SdOE) is higher, its rProt-specific activity decreases compared to the parental strain.

Given this, flask cultures with different volumes are proposed to control μ of these strains using oxygen availability (OA) with (coefficient oxygen transfer) KLa values: $10h^{-1}$(low), $50h^{-1}$(medium), and $100h^{-1}$(high). As expected, reducing the OA led to a decrease in the μ for both strains. The FdhKO-SdOE- eGfp strain exhibited μ of $0.10h^{-1}$, $0.09h^{-1}$, and $0.06h^{-1}$, while the FdhKO-eGfp strain showed μ of $0.05h^{-1}$, $0.04h^{-1}$, and $0.03h^{-1}$ for high, medium and low OA, respectively. The differences observed for μ in these strains are due to SdOE and the ability to metabolize sorbitol.

Unlike the μ, both strains' fluorescence was inversely proportional to OA. The FdhKO-eGfp strain exhibited a 12-fold lower signal at high OA than at low OA (i.e., 105267 and 8939 TFU, respectively). In the FdhKO-SdOE-eGfp strain, with a 5-fold decrease (i.e., 12184 and 2709 TFU, respectively) correlating with the formate accumulation, which decreased as the OA increased. 107,3-fold at low OA for FdhKO-eGfp strain (i.e., 26,5±4,8 mM/gDCW) compared with the lowest value for FdhKO-SdOE- eGfp strain at high OA (i.e., 0,25±0,15 mM/gDCW).

In line with these findings, rProt production is prioritized at lower μ. Thus, the SdOE increased sorbitol uptake and promoted cell growth, decreasing the rProt-specific activity. The elevated μ in the FdhKO- SdOE-eGfp strain resulted in reduced formate accumulation. Therefore, the FdhKO strain presents better specific values under evaluated conditions.

Keywords : Formate, SOR1, pAOX1, Low-Oxygen, Induction

Optimization Of The Production Of Biocontrol Agents Based On Cell Population Dynamics.

Authors : Kinore Mikaila, Frank Delvigne, and Lucas Henrion

Email address : mikaila.kinore@doct.uliege.be

Research unit : Microbial technologies

Abstract :

First identified in Africa in 2016 (Goergen *et al.,* 2016), the fall armyworm (*Spodoptera frugiperda*) is one of the most devastating pests affecting maize and other economically significant crops (Prasanna et al., 2018; FAO, 2018). This species has shown increasing resistance to chemical pesticides, highlighting the urgent need for sustainable biological control strategies.

The objective of this thesis is to develop a biological control agent by tailoring toxin production specifically to the environmental conditions within the pest's gut. Entomopathogenic bacteria will be isolated from dead *S. frugiperda* larvae collected in the fields of Burkina Faso. Using genetic engineering techniques, the bacteria will be modified to produce protein regulated by a promoter responsive to specific gut conditions.

Laboratory-scale experiments in chemostats will be conducted in bioreactors to monitor expression in real-time under targeted conditions. Toxicity tests will then be performed to evaluate the effectiveness of the bacterial toxins against *S. frugiperda* larvae. Finally, the optimization of toxin production will be carried out by analysing cell population dynamics.

This thesis aims to deliver laboratory-validated bacterial strains for further testing and field applications as biocontrol agents. Additionally, optimizing production processes will enable the industrial-scale manufacturing of these agents in bioreactors designed for local production in Burkina Faso, thereby providing a sustainable solution for pest control.

Keywords : Optimization, Spodoptera Frugiperda, Biocontrol Agents, Bacteria, Population Dynamics.

Bioprocess Development For Succinic Acid Production Using Organic Fractions Of Municipal Solid Waste

Authors : Vasiliki Korka, Christos Margioulas, Katiana Filippi, Eleni Stylianou, and Apostolis Koutinas

Email address : vkorka@doct.uliege.be

Research unit : Gestion durable des bio-agresseur (Sustainable management of bio-agressors)

Abstract :

The valorization of renewable resources is crucial for the production of various bio-based products to achieve a smooth transition to the circular economy era. The development of novel approaches to waste management is essential to develop sustainable bioprocesses. A promising one is the utilisation of renewable resources for the production of bio-based products such as succinic acid. Succinic acid is a C-4 dicarboxylic acid with major applications as a precursor for a variety of products such as medicines, cosmetics, food additives, green solvents, and biodegradable polyesters.

The aim of this study is the evaluation of *Actinobacillus succinogenes* for succinic acid production using the organic fraction of the municipal solid waste (OFMSW), focusing mainly on the fermentation's bioprocess optimization. Different neutralising agents and nitrogen sources were evaluated in order to enhance succinic acid concentration, yield and productivity.

Initially, OFMSW main components were identified, including oil (Soxhlet extraction using hexane), starch, protein (Total Kjeldahl Nitrogen), pectin, free sugars, ash, moisture and lignocellulosic content. Cellulose, hemicellulose and lignin were determined according to the method reported by the National Renewable Energy Laboratory (NREL).

Enzymatic hydrolysis of OFMSW was performed by utilizing commercial enzyme preparations containing cellulases, xylanases and arabinases. The hydrolysate produced after the enzymatic hydrolysis was used as the sole carbon source for succinic acid production with the bacterial strain *Actinobacillus succinogenes* 130Z (DSM-22257). Fermentations were carried out in a 1 L bench-top bioreactor with a 500 mL working volume. Fermentation pH was controlled at 6.7 while for pH regulation different neutralizing agents (NaOH, KOH, Mg(OH)2 and NH4OH) were evaluated. The effect of the nitrogen source was also examined by using either yeast extract or corn-steep liquor.

The produced hydrolysate, which was rich in glucose, was used as carbon source for succinic acid production. According to the results, a maximum succinic acid concentration of more than 30 g/L with yield and productivity higher than 0.6 g/g and 0.87 g/L/h were achieved.

Keywords : Succinic Acid, Actinobacillus Succinogenes, Organic Fraction Of Municipal Solid Waste (OFMSW), Neutralizing Agents

Small Isotopic Fractionation In Microbial Oil-Bed Methane Via Alkylotrophic Methanogenesis

Authors : Ling Li, Jiang Li, Quan Yuan, Yueyi Huang, Yongge Sun, Wenyi Gao, Jialai Zhong, Lin Fu, Lu Yang, Gilles Colinet, Yahai Lu, and Lei Cheng

Email address : ling.li@student.uliege.be

Research unit : Échanges Eau–Sol–Plantes (Water–Soil–Plant Exchanges)

Abstract :

The isotope signature is a powerful tool for distinguishing gas origins. Microbial oil-bed methane, formed from petroleum biodegradation, is an important energy source, contributing approximately 5-11% to natural gas. Oil-bed gas with CH4 and CO2 isotopes ranging from - 55‰ to -35‰ and > 2‰ is speculated as microbial origin, but this hypothesis lacks supporting evidence and has limited applicability. In this study, alkylotrophic methanogenesis, using various petroleum hydrocarbons as substrates, exhibited substantially smaller isotopic fractionation compared to other methanogenic pathways, with the δ^{13}C-CH4 exceeding -50‰ and reaching -40‰, accompanied by δ^{13}C-CO2 from -7‰ to 14‰. Cultivation of oil field samples harbored alkylotrophic methanogenesis activity also produced CH4 and CO2 with ^{13}C characteristics as above and closely matched the isotopic composition of natural microbial oil- bed gas. These findings imply that alkylotrophic methanogenesis could contribute to the isotopic range of microbial oil-bed gas. Furthermore, the ^{13}C signature of alkylotrophic methanogenesis displayed partial overlap with thermogenic gas, suggesting that the carbon isotopes of microbial oil-bed gas may be closer to the thermogenic gas than previously believed and the contribution of microbial methane to natural gas has likely been underestimated.

Keywords : Microbial Oil-Bed Gas, Alkyltrophic Methanogenesis, Carbon Isotopic Fractionation

Essential Oils As Alternative For Sustainable Management Of Potato Late Blight: From In Vitro Towards In Planta Experiments

Authors : Florian Martini, Clément Burgeon, Jérôme Muchembled, Eric Gontier, Haïssam Jijakli, and Marie-Laure Fauconnier

Email address : florian.martini@uliege.be

Research unit : Chimie des agro-biosystèmes (Chemistry for Sustainable Food and Environmental Systems)

Abstract :

Phytosanitary products are increasingly restricted due to environmental and health concerns, yet farmers still require solutions to combat phytopathogens. Among biocontrol strategies promoted for integrated pest management, the use of natural substances, such as essential oils, holds significant promises. They consist of complex mixtures of hydrophobic secondary metabolites with diverse biological activities, including antifungal properties. Late blight, caused by the oomycete *Phytophthora infestans*, remains a major threat to potato crop, with emerging strains showing increased virulence and resistance to conventional pesticides.

This study aimed to develop an effective biofungicide against potato late blight as well as investigate the molecular mechanisms by which essential oils disrupt pathogen metabolism.

Six essential oils—*Citrus bergamia*, *Rosmarinus officinalis*, *Origanum vulgare*, *Syzygium aromaticum*, and *Cinnamomum zeylanicum*—were selected and their chemical composition was analysed by GC-MS. The anti-oomycete potential was first assessed *in vitro* by evaluating mycelial growth (both by contact and fumigation on Petri dishes) and spores' germination (in microplates) against three *P. infestans* genotypes (EU-13-A2, EU-36-A2, and EU- 37-A2). *Ex vivo* assays were then conducted on detached potato leaves to assess the pathogenicity of these strains on three potato varieties (Bintje, Fontane, and Carolus) with varying sensitivity to late blight. Eventually, phytotoxicity threshold of microemulsions was also evaluated through chlorophyll fluorescence.

In vitro results indicated that oils rich in phenylpropanoids (*i.e* oregano, clove, and cinnamon) were more effective by totally inhibiting pathogen growth by contact (from 1µL/mL), while terpenoid-rich oils (bergamot, rosemary) were more effective through fumigation due to their higher volatility. Sensitive varieties (Fontane and Bintje) showed severe late blight symptoms, while resistant one (Carolus) did not. No significant difference in chlorophyll content was observed on potato leaves under 2,5µL/mL, but chlorosis appeared from higher concentrations, indicating phytotoxicity thresholds. These findings highlight promising essential oils for biofungicide development and set the stage for evaluating their *in vivo* effects on potato late blight pathosystem.

Keywords : Essential Oils, Phytophthora Infestans, Oomycete, Potato Late Blight, Biopesticide

Towards A Better Understanding Of The Roles Of Surfactin In Plant Responses To Stress

Authors : Roeloffs Fabian, Henrion Lucas, Grégoire Mélanie, and Delvigne Frank

Email address : froeloffs@uliege.be

Research unit : Microbial technologies

Abstract :

Bacillus subtilis is responsible for about 50% of the industrial metabolites produced with bacteria. Therefore, developing a strategy and method to control the cellular behaviour to optimize the production yield and the quality is decisive in both industry and research.

B. subtilis presents different and distinct phenotypic states apart from the baseline cell type, related to specific physiological states like sporulation, competence, biofilm and enzyme production.

The aim of this work is to develop a method to control the specific presence of these four different phenotypes of *B. subtilis* during continuous culture. To achieve it, an initial characterization of the four states will be possible in this work due to specific promotors for each phenotype connected to different fluorophores.

Microfluidic analysis using time-lapse fluorescent microscopy to determine the condition of activation of each pathway and their switching cost will be performed. The switching cost refers to the loss in growth of the cell compared to the baseline. Our previous findings suggest that modulating nutrient availability influences the diversification pathway encouraging our strategy. In this work we expect to discover a condition that triggers the specific differentiation pathway.

As a second step, the Segregostat system will be used to establish control over the appearance of phenotypes. The strategy will consists of an automated flow cytometer that enables real-time monitoring during continuous cultivation allowing for precise control over the bioreactor by dynamically adjusting the dilution rate and nutrient concentration to optimize growth and expression of the four distinct phenotypes, as tracked by specific fluorophores. The work will also enable understanding and control of the desired physiological state, in addition to grasping the fundamental aspects.

Keywords : Biotechnology, Microbiology, Systems Biology, Microfluidics, Continuous Cultivation

Characterizing And Controlling The Differentiation Dynamics Of Pathways In *Bacillus Subtilis*

Authors : Roeloffs Fabian, Henrion Lucas, Grégoire Mélanie, and Delvigne Frank

Email address : froeloffs@uliege.be

Research unit : Microbial technologies

Abstract :

Bacillus subtilis is responsible for about 50% of the industrial metabolites produced with bacteria. Therefore, developing a strategy and method to control the cellular behaviour to optimize the production yield and the quality is decisive in both industry and research.

B. subtilis presents different and distinct phenotypic states apart from the baseline cell type, related to specific physiological states like sporulation, competence, biofilm and enzyme production.

The aim of this work is to develop a method to control the specific presence of these four different phenotypes of *B. subtilis* during continuous culture. To achieve it, an initial characterization of the four states will be possible in this work due to specific promotors for each phenotype connected to different fluorophores.

Microfluidic analysis using time-lapse fluorescent microscopy to determine the condition of activation of each pathway and their switching cost will be performed. The switching cost refers to the loss in growth of the cell compared to the baseline. Our previous findings suggest that modulating nutrient availability influences the diversification pathway encouraging our strategy. In this work we expect to discover a condition that triggers the specific differentiation pathway.

As a second step, the Segregostat system will be used to establish control over the appearance of phenotypes. The strategy will consists of an automated flow cytometer that enables real-time monitoring during continuous cultivation allowing for precise control over the bioreactor by dynamically adjusting the dilution rate and nutrient concentration to optimize growth and expression of the four distinct phenotypes, as tracked by specific fluorophores. The work will also enable understanding and control of the desired physiological state, in addition to grasping the fundamental aspects.

Keywords : Biotechnology, Microbiology, Systems Biology, Microfluidics, Continuous Cultivation

«Love Is In The Air»: Identification Of The Putative Sex Pheromone Of *Harmonia Quadripunctata*

Authors : Anaïs Sion and François J. Verheggen

Email address : anais.sion@doct.uliege.be

Research unit : Gestion durable des bio-agresseur (Sustainable management of bio-agressors)

Abstract :

The first sex pheromone in a lady beetle species has been identified recently in the Asian lady beetle, *Harmonia axyridis* (Coleoptera, Coccinellidae). In the presence of aphid prey, mature females exhibit a stereotyped calling behavior that leads to the emission of a mixture of five terpenes that is attractive to males and induces copulation. While the calling behavior has already been observed in several coccinellids, the presence of similar pheromonal communication in other coccinellid species has not been studied.

To assess the conservation of chemical communication mechanisms within the genus, in this study, we investigated the potential emission of a sexual pheromone in *Harmonia quadripunctata.*

H. quadripunctata individuals were collected in the field and reared under laboratory conditions. Their offspring larvae were fed aphids *ad libitum* throughout their development. Prior to reaching sexual maturity, adults were separated by sex. Adults were maintained on a diet of sugar lumps and multiflower pollen for the first six days post-emergence, followed by aphids *ad libitum.*

Volatile organic compounds (VOCs) emitted by adults were sampled after 15 and 20 days, with fifteen replicates per sex and age group. VOCs emitted were collected using dynamic headspace sampling and analyzed by TD-GC-MS. At 15 days, no significant differences in VOC profiles between males and females were observed. However, at 20 days, three compounds—β- caryophyllene, β-elemene, and α-humulene—were detected exclusively in females. These compounds are common with the *H. axyridis* sexual pheromone.

These results suggest that *H. quadripunctata* females may emit a sex pheromone similar to that of *H. axyridis*, indicating a potential conserved chemical communication mechanism within the genus. Further behavioral assays are necessary to confirm the functional role of these compounds in mate attraction. This study contributes to our understanding of sexual communication in coccinellids and may inform future phylogenetic analyses within this family.

Keywords : Sexual Pheromone, Lady Beetle, Coccinellidae, Volatile Organic Compounds, Semiochemical

Antiplasmodial Activity Of A New Chemotype Of *Croton Sylvaticus* Essential Oils

Authors : Pierre Leonel K. Tafokeu Taguimjeu, Manon Genva, Yannick Stéphane Fongang Fotsing, and Marie-Laure Fauconnier

Email address : pltaguimjeu@uliege.be

Research unit : Chimie des agro-biosystèmes (Chemistry for Sustainable Food and Environmental Systems)

Abstract :

In the context of malaria elimination, the development of new antimalarial agents with dual activity, targeting both the asexual and sexual stages of *Plasmodium falciparum* is of paramount importance. The pivotal role of plant-derived natural products in the discovery of antimalarial drugs inspired us to investigate bioactive compounds with dual activity from *Croton sylvaticus*, a medicinal plant traditionally used to treat malaria.

This study aims to scientifically validate the traditional medicinal use of *C. sylvaticus*, particularly for malaria treatment, by analyzing its essential oils (EOs) and evaluating their antiplasmodial activity.

EOs were extracted from the plant's leaves, roots, and trunk bark using hydrodistillation. Their chemical composition was analyzed through gas chromatography- mass spectrometry (GC-MS), and their effects were tested *in vitro* against both asexual and sexual stages of *P. falciparum*.

Results showed that the major constituents identified were viridiflorene (18.13 ± 0.46%) in root EO, (E)-*β*-caryophyllene (18.40 ± 0.60%) in trunk bark EO, and farnesyl acetone (15.26 ± 0.25%) in leaf EO. Notably, the leaf EO of Cameroonian *C. sylvaticus* exhibited a distinct and newly described chemotype, characterized by high levels of farnesyl acetone, *β*-copaene-4-*α*-ol, *β*-cadinene, *α*-humulene, and *trans*-longipinocarveol. *In vitro* testing revealed significant antiplasmodial activity against both the asexual and sexual stages of *P. falciparum*, with trunk bark EO demonstrating the highest potency (IC50: 9.06 ± 2.15 µg/mL for *Pf*3D7 and 0.56 µg/mL for gametocytes). Caryophyllene oxide (IC50 = 0.48 *µ*g/mL), (E)-*β*-caryophyllene (IC50 = 1.15 *µ*g/mL), and sclareol (IC50 = 1.30 *µ*g/mL), the major compounds in the trunk bark EO, play a crucial role in the dual antiplasmodial efficacy of the EO extracted from the trunk bark of *C. sylvaticus*.

These findings support the traditional antimalarial use of *C. sylvaticus* and stimulate further research in this critical field.

Keywords : Croton Sylvaticus, Essential Oils, Antiplasmodial Assay

A High-Quality Assembly Revealing PMEL Gene For Unique Plumage Phenotype In *Liancheng Ducks*

Authors :

Email address : zhen.wang@doct.uliege.be

Research unit : Ingénierie des productions animales et nutrition (Animal Sciences)

Abstract :

Plumage coloration is a distinctive trait in ducks, and the Liancheng duck, characterized by its white plumage and black beak and webbed feet, serves as an excellent subject for such studies. However, academic comprehension of the genetic mechanisms underlying duck plumage coloration remains limited.

We aim to explore the genetic mechanism of white feather formation in Liancheng ducks and offer significant insights and direction for future studies and breeding programs aimed at understanding and manipulating avian plumage coloration.

The Liancheng duck genome (GCA_039998735.1) was hereby *de novo* assembled using HiFi reads, and F2 segregating populations were generated from Liancheng and Pekin ducks. The aim was to identify the genetic mechanism of white plumage in Liancheng ducks.

In this study, 1.29 Gb Liancheng duck genome was *de novo* assembled, involving a contig N50 of 12.17 Mb and a scaffold N50 of 83.98 Mb. Beyond the epistatic effect of the *MITF* gene, GWAS analysis pinpointed a 0.8Mb genomic region encompassing the *PMEL* gene. Additionally, Linkage Disequilibrium (LD) analysis revealed two candidate SNPs (Chr33:5,303,994A>G; 5,303,997A>G) that might alter *PMEL* transcription, potentially influencing plumage coloration in Liancheng ducks. Our study has assembled a high-quality genome for the Liancheng duck and has presented compelling evidence that the white plumage characteristic of this breed is attributable to the *PMEL* gene.

Keywords : Duck, Genome Assembly, Plumage Color, PMEL, Melanin

Reinforcement Of Chitosan/ Polyvinyl Alcohol Film By Quercetin Self-Assembled Nanoparticles For Meat Preservation

Authors : Simin Fan, Dequan Zhang, Wenxin Wang, Chaoqiao Zhu, Ming Tian, Aurore Richel, Marie-Laure Fauconnier, and Chengli Hou

Email address : simin.fan@student.uliege.be

Research unit : Technologies alimentaires (Food Technology)

Abstract :

The development of sustainable and functionally enhanced food packaging materials is essential to mitigate food waste. Herein, quercetin nanoparticles (QNs) are synthesized and utilized to enhance the functionality of chitosan/ polyvinyl alcohol (CS/PVA) film. Molecular dynamics simulation and experimental characterizations revealed that the self-assembly of QNs is primarily driven by supramolecular interactions. QNs exhibit good compatibility with CS/PVA film, serving both as a nanofiller to improve mechanical properties (with a tensile strength of 49.68 MPa and an elongation at break of 176.02%) and as an active agent to impart antioxidant properties, achieving a fourfold increase compared to plain CS/PVA film. Additionally, QNs enhance the thermal stability, UV-blocking capability, and water vapor barrier properties of the CS/PVA films. More importantly, the QNs-reinforced CS/PVA films significantly extend the shelf life of fresh meat to 11 days. This work provides an effective strategy for fabricating eco-friendly and functional food packaging materials, demonstrating great potential for application in food preservation.

Keywords : Active Packaging, Chitosan/ Polyvinyl Alcohol Film, Quercetin Nanoparticles, Molecular Dynamics Simulation, Meat Preservation

Comparing Genetic Architecture Of Predicted Negative Energy Balance And Its Biomarkers Of First-Parity Holstein Cows In Early Lactation

Authors : H. Hu, H. Atashi, Y. Chen, C. Grelet, S. Franceschini, H. Soyeurt, and N. Gengler

Email address : hongqing.hu@doct.uliege.be

Research unit : Ingénierie des productions animales et nutrition (Animal Sciences)

Abstract :

During early lactation, negative energy balance significantly affects the health and productivity of dairy cows. However, there is still a lack of research on predicting negative energy balance (PNEB) in dairy cows and the genetic architecture of its associated biomarkers.

The aims of this study were to (1) compare genetic correlations calculated based on SNP solutions from 20 univariate repeatability models with those of the 20-trait repeatability model and (2) compare the genetic correlations between PNEB and 19 traits based on SNP solutions for each chromosome.

The 20 traits included PNEB, a novel Energy Deficit Score (EDS), 15 biomarkers predicted using milk mid-infrared (MIR) spectral, and 3 production traits (milk yield, fat and protein parentage). In total, 30,364 records from 25,287 first-parity cows were used. The pedigree included 74,662 animals, among which 3,757 had 566,170 SNPs. Genetic parameters were estimated using 20 univariate repeatability models and a 20-trait repeatability model without genome information.

The 20 studied traits had moderate h2 (range 0.21 to 0.31), except citrate (0.40). The studied 20 traits had moderate repeatability (range 0.22 to 0.42), except milk yield (0.58). The genetic correlations between PNEB and its biomarkers, derived from SNP solutions for single-trait repeatability model, ranged from -0.56 (blood insulin-like growth factor 1, IGF-1) to 0.81 (EDS). These correlations were comparable to those obtained from a multi-trait repeatability model, where the range is from -0.60 (IGF-1) to 0.87 (non-esterified fatty acids, NEFA). Additionally, the genetic correlation between PNEB and 5 traits on chromosome 25 is significantly high. These results provide valuable insights for improving energy balance and health in dairy cows through genetic selection, offering potential for enhanced productivity and cow welfare.

Keywords : Negative Energy Balance, Biomarkers, Genetic Correlation, Mid-Infrared (MIR) Spectral

Valorization Of Black Soldier Fly *Hermetia Illucens* Larvae As An Alternative Protein Source For Post-Weaning Piglet Nutrition

Authors : Hugo Luttenschlager, Joachim Carpentier, Nicolas Deville, Yves Beckers, José Wavreille, Christophe Blecker, Giorgia Purcaro, Maesen Philippe, Aurore Richel, Frédéric Francis, Sabine Danthine, Sebastien Finet, and Rudy Caparros Megido

Email address : hluttenschlager@uliege.be

Research unit : Gestion durable des bio-agresseur (Sustainable management of bio-agressors)

Abstract :

Agriculture significantly impacts the environment and human health through greenhouse gas emissions, eutrophication of natural habitats, land-use competition, pesticide and antibiotic use, and the spread of diseases. Globally, food losses and waste account for one-third of agricultural production, even as many countries face food insecurity. The valorization and treatment of bio- waste present an opportunity to address these critical challenges. The use of black soldier fly larvae (BSFL) has recently emerged as a novel method to convert bio-waste into high-quality protein and lipid sources.

The feasibility of BSFL production based on the collection of bio-waste for feeding post-weaning piglets was assessed.

A total of 4,730 kg of organic fruits and vegetables, bread, and brewery by-products were collected from local stores and breweries, yielding 555 kg of wet larvae. After being dried and defatted, and based on their profiles in lipids, fatty acids, proteins, amino acids, ash, carbohydrates, and digestibility, the processed insect proteins were used to formulate piglet diets with varying levels of soybean replacement.

The post-weaning piglet trial will aim to determine the inclusion rate of BSFL proteins that provides a viable alternative from both zootechnical and economic perspectives.

Keywords : Edible Insect, Animal Nutrition, Waste Management

Interaction Between Egg White And *Faba Bean* Proteins During The Heat- Induced Gelling Process And Its Effects On Textural And Structural Properties

Authors : Fangzhou Wanga, Romdhane Karouib, and Christophe Bleckera

Email address : fangzhou.wang@doct.uliege.be

Research unit : Technologies alimentaires (Food Technology)

Abstract :

The partial substitution of animal-based protein using plant-based protein can not only reduce the cost but also lower the ecological footprint in food industries. Egg white (EW), as a conventional gelling material, is being partially replaced due to its high price. Faba bean is an emerging source of protein and is considered an alternative to soybean in the future due to its high protein content and functional properties, including gelling properties. However, the protein-protein interaction between EW and faba protein (FP) made it deviate from the expected gelling performance, which affected the quality of the final products and cannot be neglected.

To characterize the gelling properties of the composite gel from EW and FP and to explore the mechanism of the protein interaction between them.

Composite gels were prepared using EW and PF at ratios of 10:0, 8:2, 6:4, 4:6, 2:8, and 0:10. The textural properties and water-holding capacity (WHC) were characterized, and the surface hydrophobicity and microstructure were determined to understand the mechanism during the gel formation.

The increasing FP content led to significant modification of texture properties. More specifically, hardness decreased from 1275.44 g to 107.45 g, and gumminess from 702.00 to 46.59. The mixing group of 6:4 and 4:6 had minimal resilience and cohesiveness, respectively, while the springiness showed an uptrend and had a maximum of 96.64% in the 4:6 group. The WHC presented a negative synergy in mixed gels, and the ratio 6:4 led to a minimum of 56.97% The change of texture and WHC could be explained by the protein-protein interaction, which was proved by the increased protein surface hydrophobicity delivering the heterogeneous gel microstructure to different extents.

Keywords : Gelling Properties, Egg White, Faba Bean Protein, Protein-Protein Interaction, Microstructure

Study Of The Flavor Dissipation Mechanism Of Soy-Sauce-Marinated Beef Using Flavor Matrices

Authors : Jingfan Wang, Ping Yang, Junmei Liu, Dong Han, Chunhui Zhang, Giorgia Purcaro, and Marie-Laure Fauconnier

Email address : jingfan.wang@student.uliege.be

Research unit : Technologies alimentaires (Food Technology)

Abstract :

Soy sauce-based marinade beef (SSMB) is a traditional Chinese cuisine with a unique flavor. However, pre-precooling and air-cooling tunnels are necessary industrial units in the cold chain for flavor dissipation.

This study aimed to elucidate the dissipation mechanism of key aroma-active compounds in SSMB during cooling

The key aroma-active compounds in SSMB that had just completed (100°C), pre-cooled in the brine tanks (45°C), and exited the air-cooleded tunnel (10°C) were characterized by sensory-directed flavor analysis. The volatile compounds in each were analyzed by sensory-directed flavor analysis, such as gas chromatography-olfactometry-mass spectrometry GC-O-MS, aroma extract dilution analysis (AEDA), odor activity value (OAV), and aroma recombination and omission experiment

We identified 110 aroma-active substances, of which 42 were quantified based on their high flavor dilution factors. Recombination and omission tests identified 29 odorants as the main aroma-active molecules Additionally, the flavormatrix revealed the relationship between the aroma component expression and sensory attributes. Flavor substances derived from spices, such as eugenol, anethole, and linalool, are enriched during the pre - cooling stage. The different meat attributes of the three samples were primarily related to aldehydes generated from lipid oxidation. Further studies are needed to evaluate the dynamic kinetic changes in key aroma-active compounds throughout the cooling process of SSMB.

Keywords : Soy Sauce-Based Marinated Beef, Cooling Processing, Sensory-Directed Flavoru Analysis, Odoru Activity Value, Aroma-Active Compound

Structure Formation Mechanism Of Pectin-Soy Protein Isolate Gels: Unraveling The Role Of Peach Pectin

Authors : Jin Xie, Jinfeng Bi*, Nicolas Jacquet, Christophe Blecker, Shuhan Feng, Xiaoxian Liu, and Jian Lyua*

Email address : jin.xie@student.uliege.be

Research unit : Technologies alimentaires (Food Technology)

Abstract :

This study investigated the macro & micro properties of the composite gels formed by soy protein isolate (SPI) and peach pectin fractions: water-soluble pectin (WSP), chelator- soluble pectin (CSP), and sodium carbonate soluble pectin (NSP). Specially, the interaction between pectin fractions and SPI was studied to explain the formation mechanism of the composite gels. WSP, as a high methoxyl pectin, exhibited rich branching (sugar ratio B = 3.10). CSP, as a low methoxyl pectin, depicted a high linearity. NSP, with low linearity (sugar ratio A = 6.14), contained numerous side chains. Due to the strong interaction between pectin fractions and SPI, the new composites with excellent dense network microstructures were formed, accompanied by increased apparent viscosity, higher G' and G', and reduced particle size. XRD and FT-IR analysis highlighted the modifications in gel structures. SEM-energy dispersive X- ray spectroscopy observed elemental distribution and framework composition in pectin-SPI gels. Hydrophobic interaction was the most important chemical force in pectin-SPI binding. Molecular docking results indicated that galacturonic acid in pectin bound more strongly to 7S than to 11S, with tighter hydrogen bonds. Notably, WSP-SPI showed the lowest turbidity, indicating enhanced solubility and particle dispersion, which helped prevent aggregation. CSP-SPI demonstrated the highest G' and G'', ascribing to the high linearity and abundant carboxyl groups in CSP. NSP-SPI showed the highest apparent viscosity and irregular structure. Overall, the texture properties of pectin-SPI gels were driven by pectin's structure properties, which would provide new and valuable information for texture control in gel formulation.

Keywords : Peach Pectin, Soy Protein Isolate, Rheological Property, SEM-Dispersive X-Ray Spectroscopy, Chemical Force

Harnessing Microbial Biotechnology For Sustainable Animal Feed: Innovations In Probiotic Development And Application.

Authors : Ange Yao, Hary Razafindralambo, and Philippe Jacques

Email address : aop.yao@doct.uliege.be

Research unit : Microbial technologies

Abstract :

The contemporary world faces numerous challenges pertaining to health and food safety. Foremost among these is the imperative to meet the global demand for nutritious, high-quality food, a concern that has heightened societal awareness regarding the presence of harmful chemical residues, such as pesticides and antibiotics, arising from certain agricultural practices. Consequently, the European Union implemented a prohibition on the uncontrolled use of antibiotic growth promoters (AGPs), prompting increased interest in sustainable alternatives for plants, and animals. Potential alternatives include the utilization of probiotics, which are live microorganisms that, when consumed in sufficient quantities, exert beneficial and regulatory effects on the microbiota, thereby influencing the host's health positively.

The objective of this research is to develop synbiotic (probiotics combined with prebiotic) for application in animal feed. This involves isolating microbial strains from indigenous African matrices, followed by their identification through 16S rRNA gene sequencing and subsequent confirmation via MALDI-TOF mass spectrometry. The probiotic potential of these strains is then rigorously evaluated.

Around hundred strains (lactic acid bacteria, *Bacillus* and some yeasts) are identified and characterized based on criteria defined by the FAO. These criteria include the study their viability in acid conditions, their surface hydrophobicity, their self-aggregation capacity, their ability to express antagonistic activity towards pathogens and their ability to colonise the gastrointestinal tract.

Five strains of lactic acid bacteria tested (*Lactobacillus plantarum, Leuconostoc mesenteroides, Enterococcus durans* and *Lactobacillus casei*) inhibit the growth of pathogens and are enabled to produce a wide range of compound such as emulsifying agents, short chain fatty acid with spectacular capacities against pathogens.

Keywords : Synbiotic, Probiotics, Lactic Acid Bacteria, Antagonism, Fishes

Effect Of Inulin On Small Extracellular Vesicles MicroRNAs In Milk From Dairy Cows With Sub-Clinical Mastitis

Authors : Wanjie Yu, Xuemei Nan, Martine Schroyen, Yue Wang, Mengting Zhou, Xiangfang Tang, and Benhai Xiong

Email address : wanjie.yu@student.uliege.be

Research unit : Ingénierie des productions animales et nutrition (Animal Sciences)

Abstract :

Milk contains microRNAs (miRNA) that are shielded by small extracellular vesicles (sEVs). Beyond variations among individuals, many factors, including nutrition, play a role in shaping miRNA expression profiles. This study is to explore milk-derived sEVs-miRNA variations induced by inulin supplementation in sub-clinical mastitis-suffering cows. Fourteen lactating cows diagnosed with sub-clinical mastitis were equally assigned to either an inulin or a control group. Apart from total mixed rations, cows in the inulin group were provided with 300 g/d inulin during the morning feeding, while the control group did not receive any supplement. Following 1 week of adaptation and 5 weeks of treatment, sEVs-miRNA were isolated from the milk of each cow. RNA was subjected to high-throughput sequencing and differentially expressed (DE) miRNAs ($p < 0.05$ and $|log2FC| > 1$) were detected through bioinformatics analysis. Gene Ontology (GO) enrichment and Kyoto Encyclopedia of Genes and Genomes (KEGG) pathway analyses were conducted to examine the target genes of DE miRNAs. A sum of 350 miRNAs were discovered, including 332 in the control group and 249 in the inulin group. Among these, 9 miRNAs showed differential expression within the two groups, including 3 upregulated and 6 downregulated in the inulin group. The DE miRNAs were found to play a role in regulating organismal systems, cellular processes, and signal transduction, potentially affecting inflammatory response and milk production. Overall, our study provides insight into the micromolecular-level mechanism of inulin in alleviating sub-clinical mastitis in dairy cows.

Keywords : Inulin, Milk Microrna, Pathways, Inflammation, Sub-Clinical Mastitis

Autors :